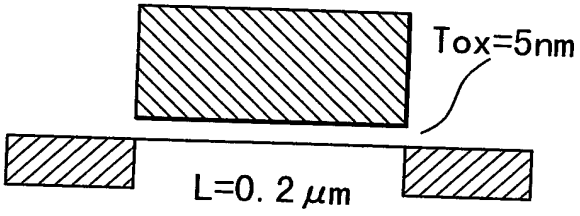


- GATE INSULATION FILM LEAKAGE (LIMIT DOWN TO Tox=3.0nm) TUNNELING→DIRECT TUNNELING
- SHORT CHANNEL EFFECT IS REMARKABLE.

FIG. 1A (PRIOR ART)

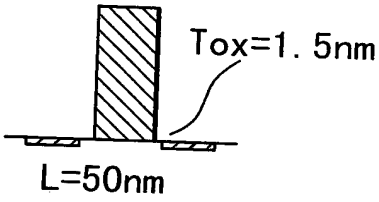
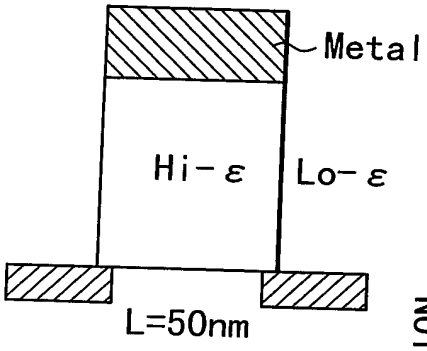


FIG. 1B



	Tef= 1.5nm	Tef= 3.0nm
TiO_2	30nm	60nm
$SrTiO_3$	75nm	150nm
BST	110nm	220nm

AR=0.6～4.4

HIGT DIELECTRIC SUBSTANCE INSULATION FILM
IN THE EFFECT OXIDE FILM CONVERSION

⇩

LARGE LEAKAGE CURRENT
LOW INSULATION BREAK-DOWN VOLTAGE

⇩

HARD TO MAKE FILM THIN.

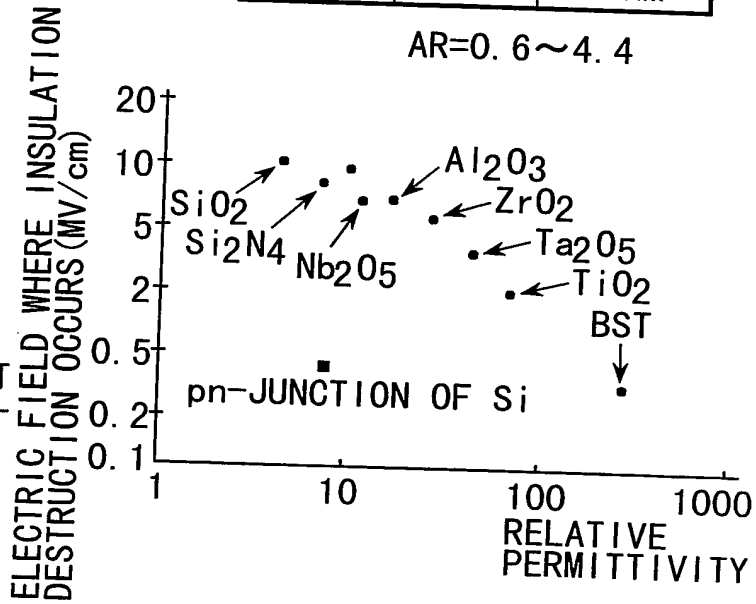
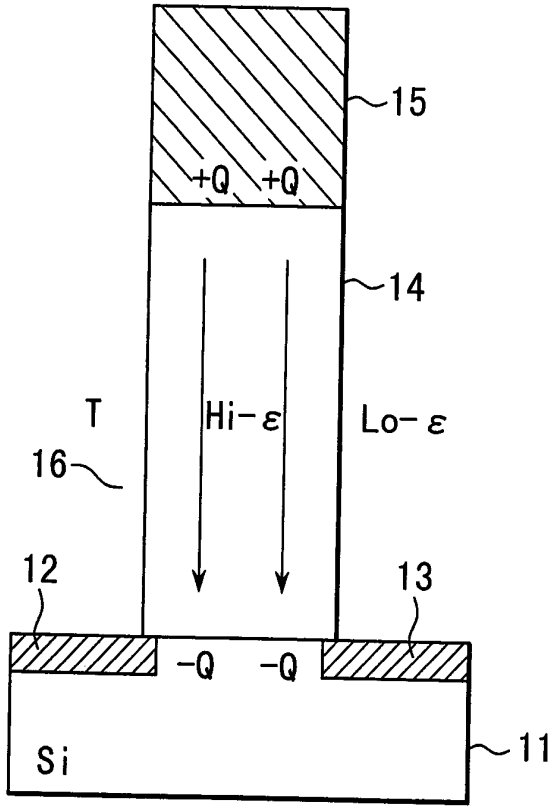
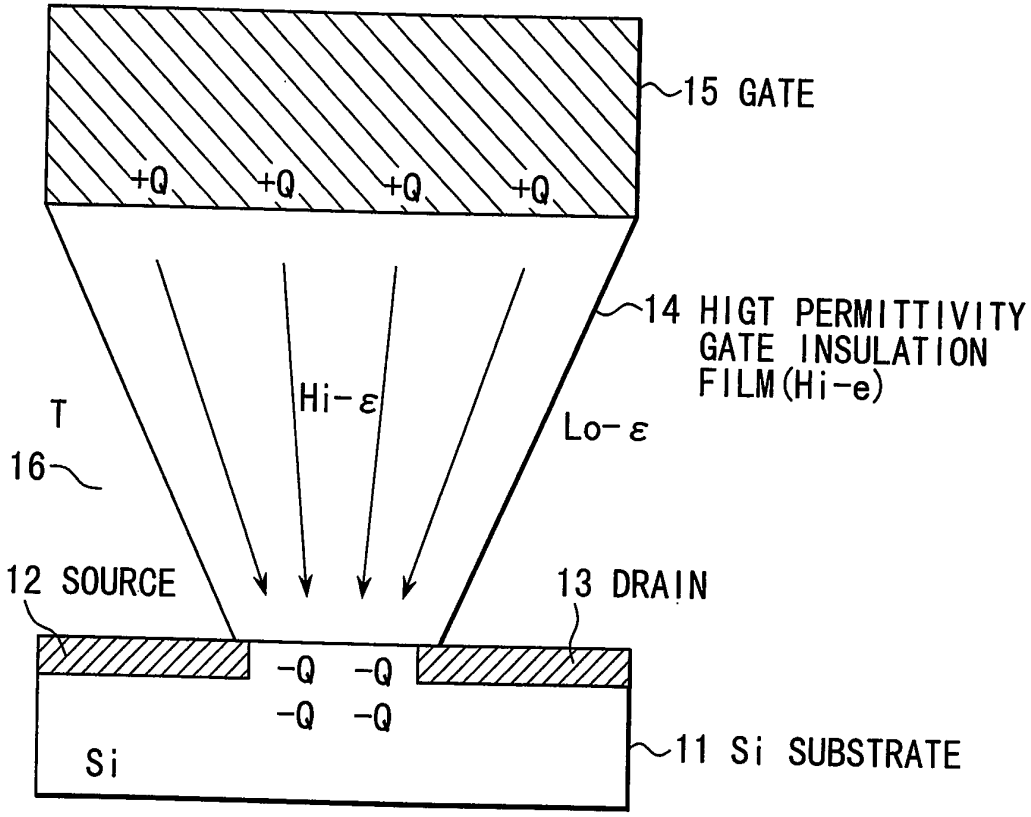


FIG. 2 (PRIOR ART)



CONSTANT ELECTRIC FLUX DENSITY
CHANNEL CHARGE DENSITY(σ)
$=\varepsilon E=\varepsilon V/T$

FIG. 3A (PRIOR ART)



ELECTRIC FLUX CONCENTRATED
CHANNEL CHARGE DENSITY(σ)
$\sigma > \varepsilon V/T$

FIG. 3B

CHANNEL CHARGE DENSITY $\sigma = \varepsilon \frac{V}{T}$

$$\sigma = \varepsilon \frac{V}{T} \left(\frac{\frac{LT}{LB} - 1}{Ln\left(\frac{LT}{LB}\right)} \right)$$

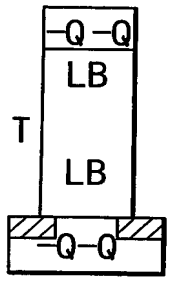
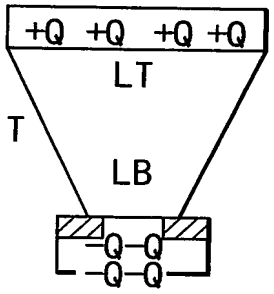
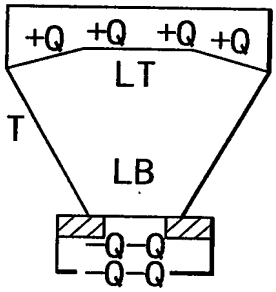


FIG. 4A
(PRIOR ART)



TRAPEZOID

FIG. 4B



SECTOR

FIG. 4C

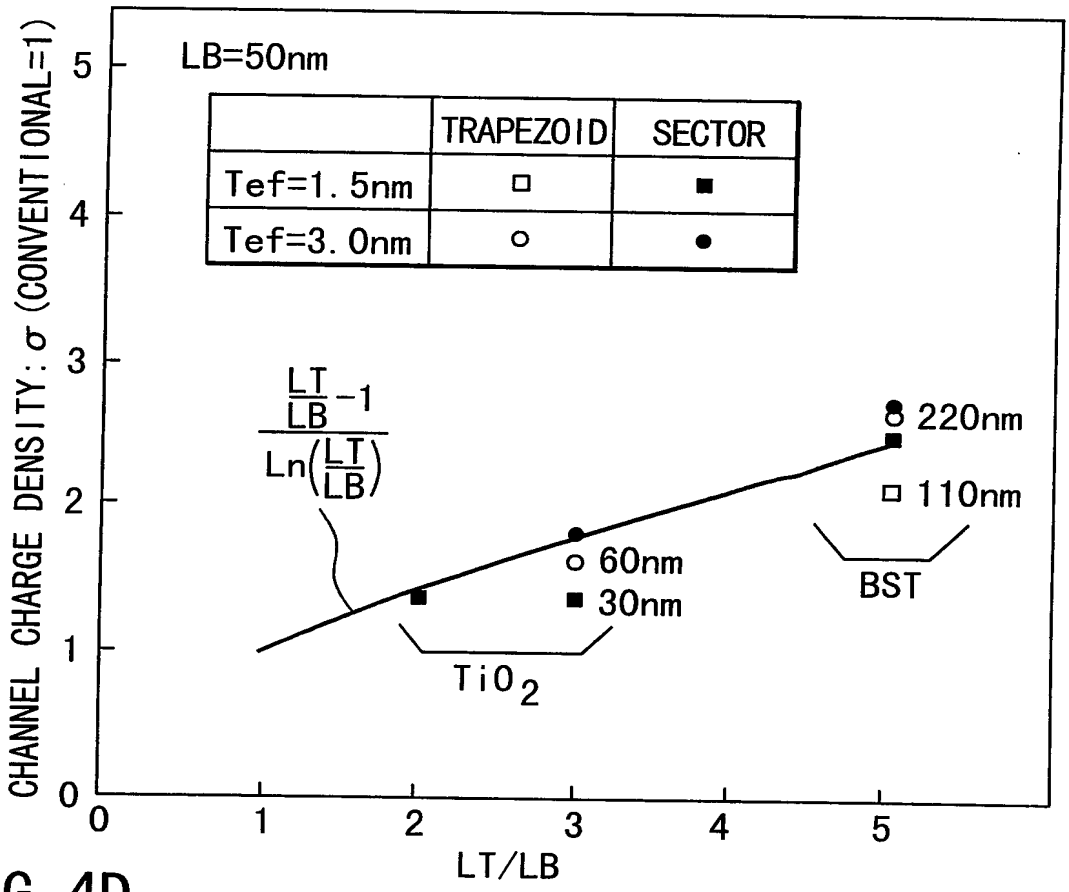
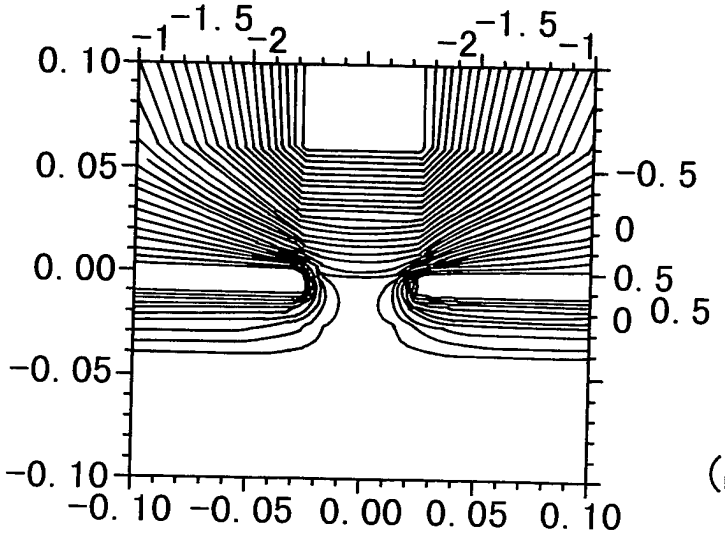


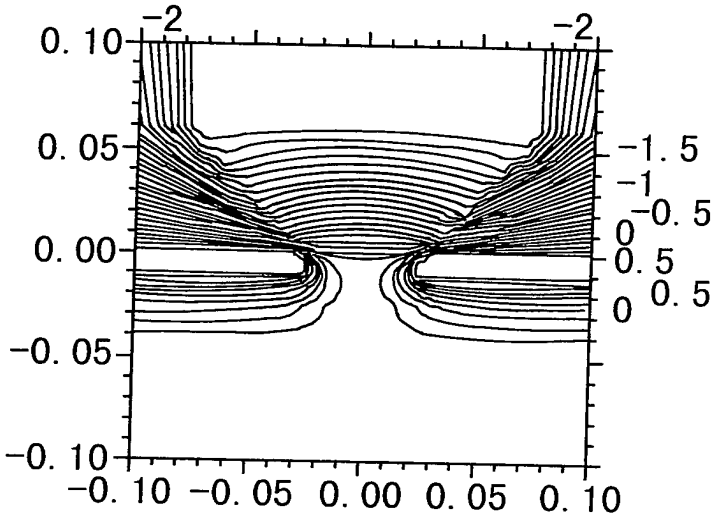
FIG. 4D



CONVENTIONAL (LT/LB=1)
Cgb=0.47fF/μm
(1.00 TIMES)

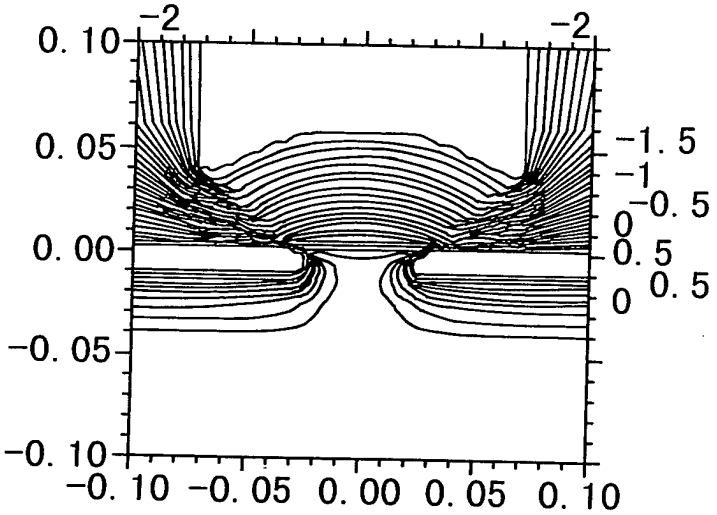
(PARALLEL-MONOTONOUS APPROXIMATION =0.59fF/μm)

FIG. 5A
(PRIOR ART)



TRAPEZOID (LT/LB=3)
Cgb=0.79fF/μm
(1.67 TIMES)

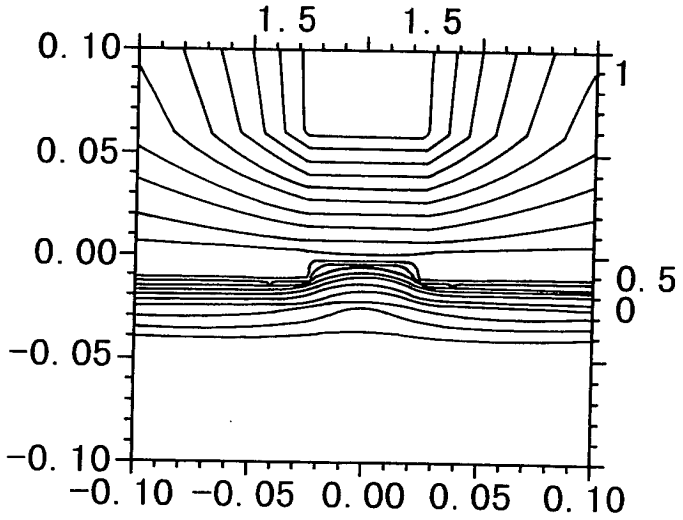
FIG. 5B



SECTOR (LT/LB=3)
Cgb=0.86fF/μm
(1.83 TIMES)

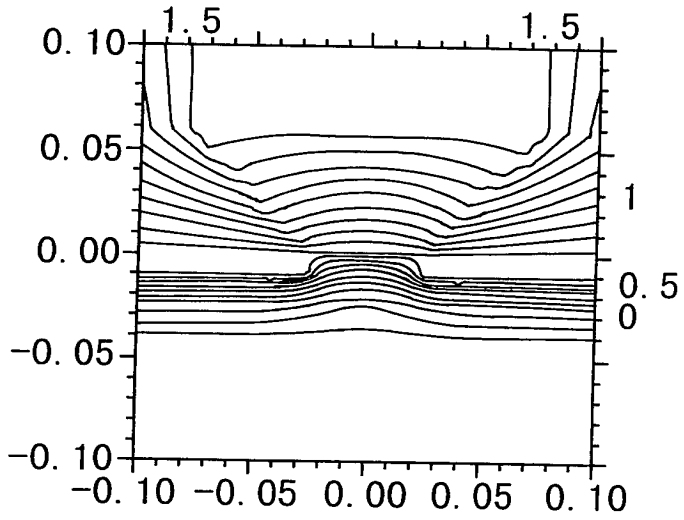
FIG. 5C

EQUIPOTENTIAL LINE CHART
(Vg=-3V) Vd=Vs=Vb=0V, 0.1V/div
(T=60nm, (Tef=3nm), LB=50nm, εr=80(TiO_2))



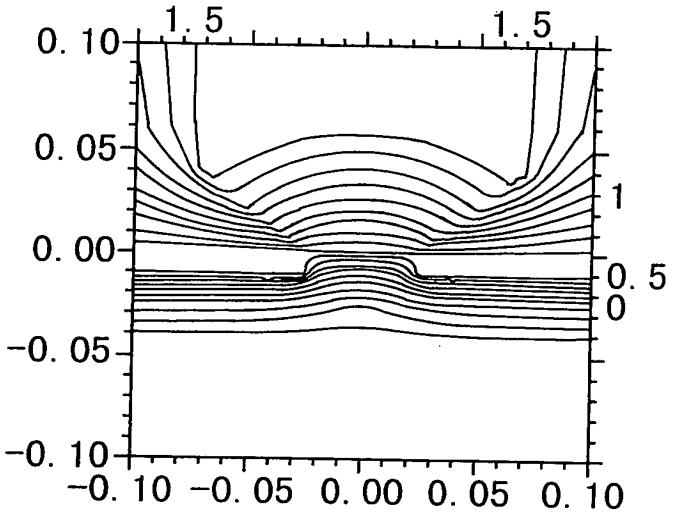
(LT/LB=1)

FIG. 6A
(PRIOR ART)



TRAPEZOID (LT/LB=3)

FIG. 6B



SECTOR (LT/LB=3)

FIG. 6C

EQUIPOTENTIAL LINE CHART
(Vg=1V) Vd=Vs=Vb=0V, 0.1V/div
(T=60nm, (Tef=3nm), LB=50nm, εr=80(TiO_2))

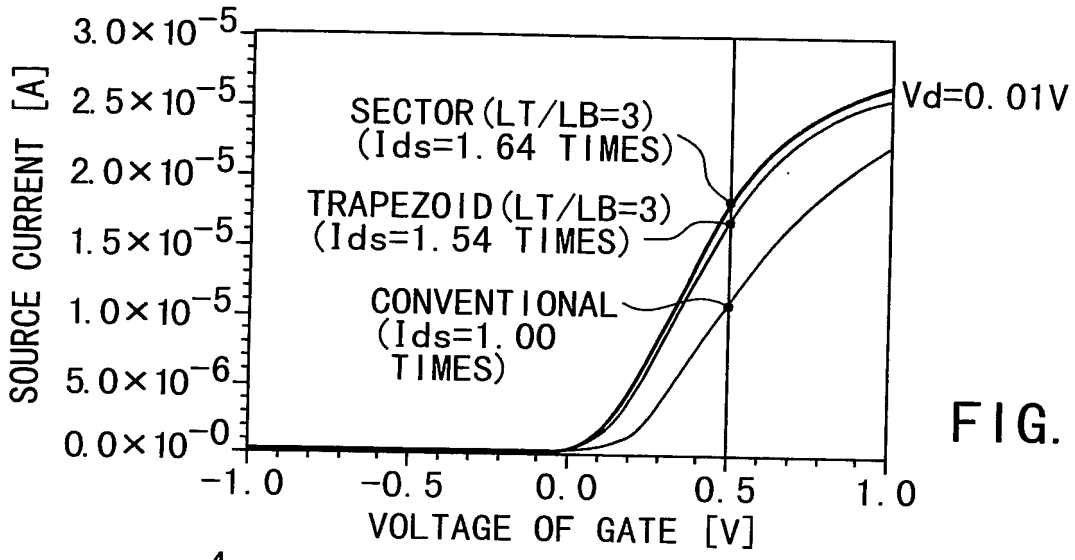


FIG. 7A

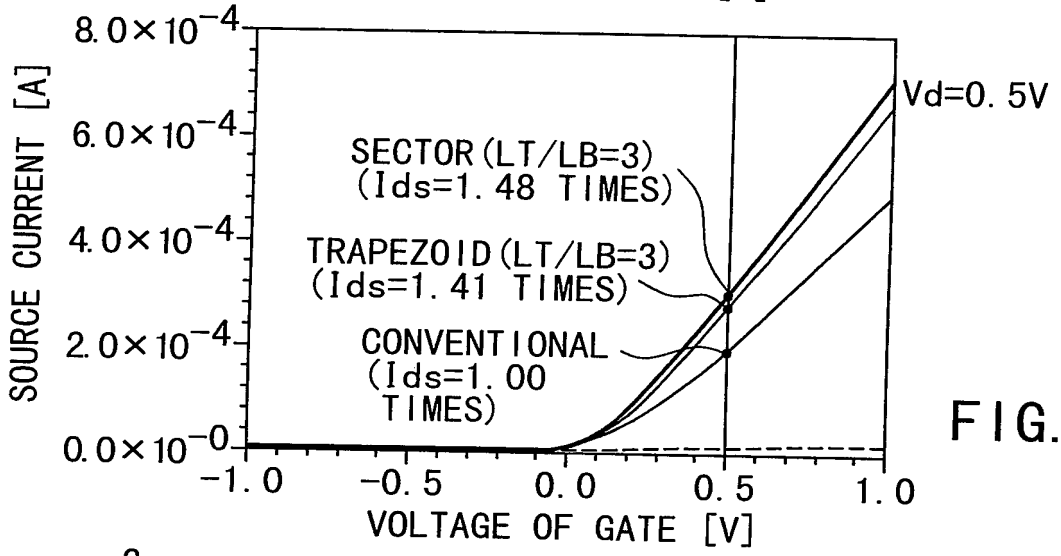


FIG. 7B

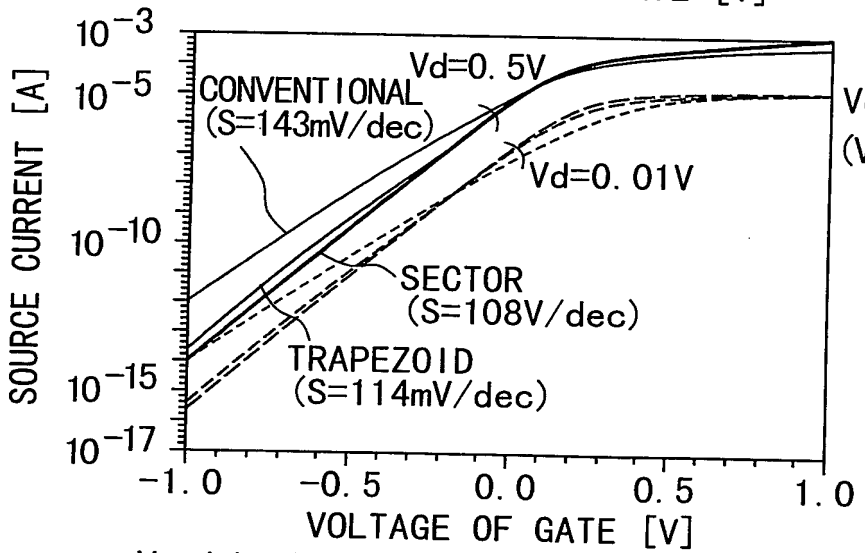


FIG. 7C

Vg=Ids CHARACTERISTIC (Tef=3nm TiO_2)
(T=60nm, LB=50nm, ε r=80)

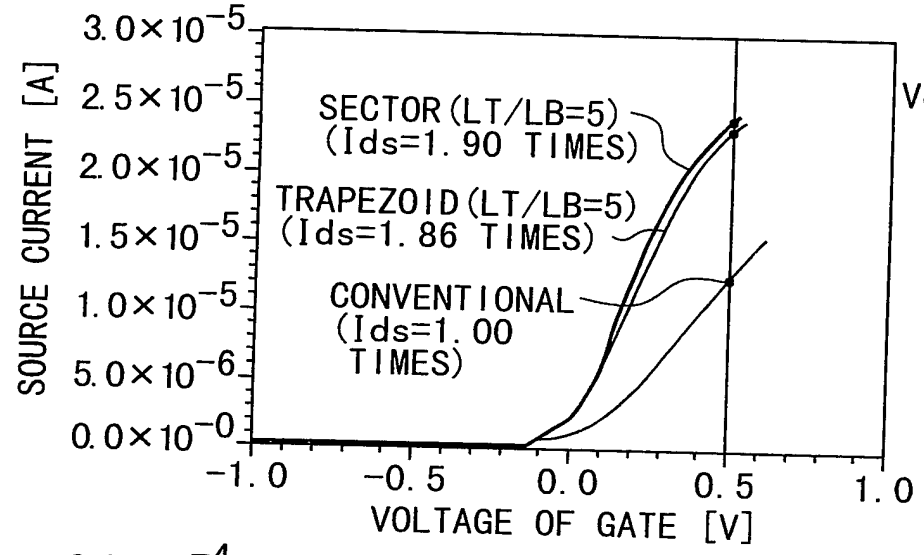


FIG. 8A

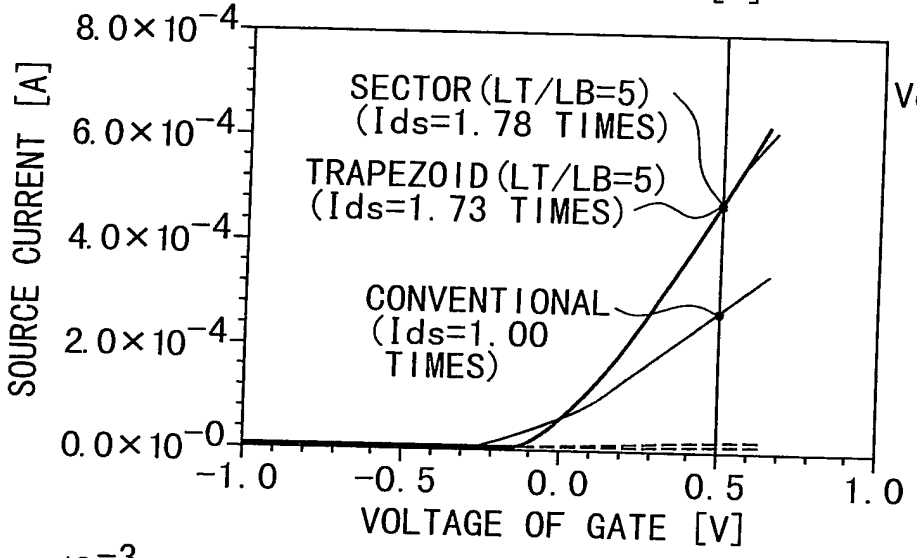


FIG. 8B

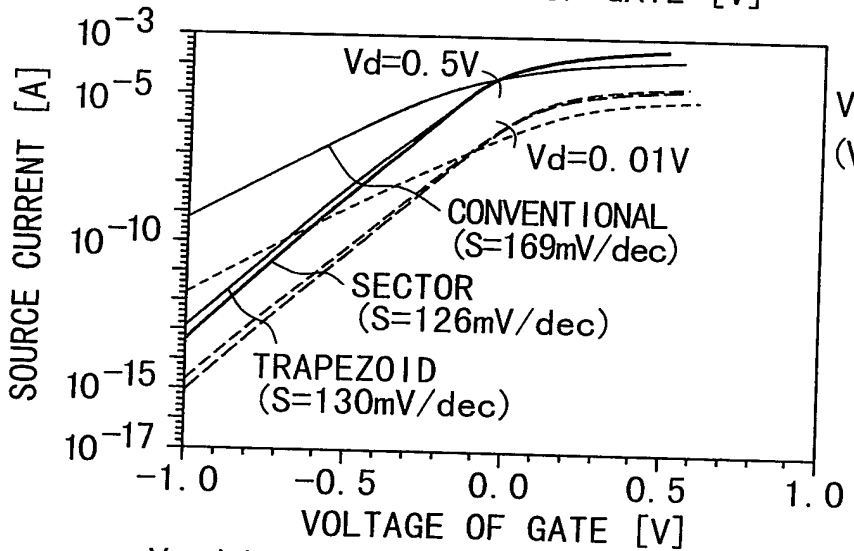


FIG. 8C

Vg=Ids CHARACTERISTIC (Tef=3nm BST)
(T=220nm, LB=50nm, εr=300)

DISTRIBUTION OF ELECTRIC FIELD IN INSULATION FILM
(Vd=Vs=Vb=0V, T=60nm, (Tef=3nm), LB=50nm, εr=80(TiO_2))

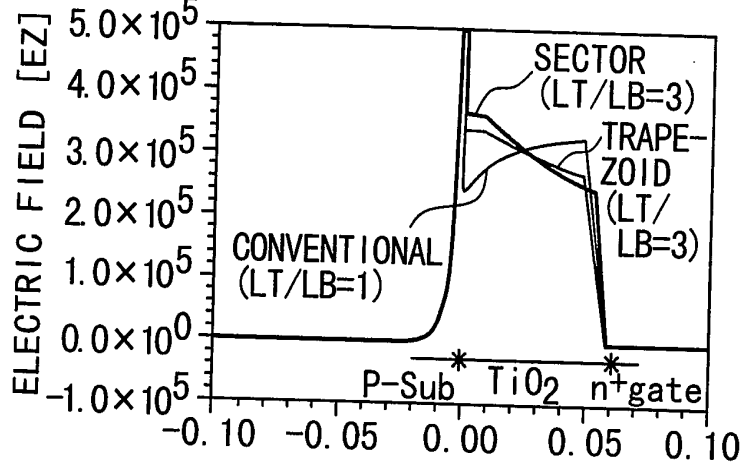


FIG. 9B (a-1) Vg=3V, X=0nm

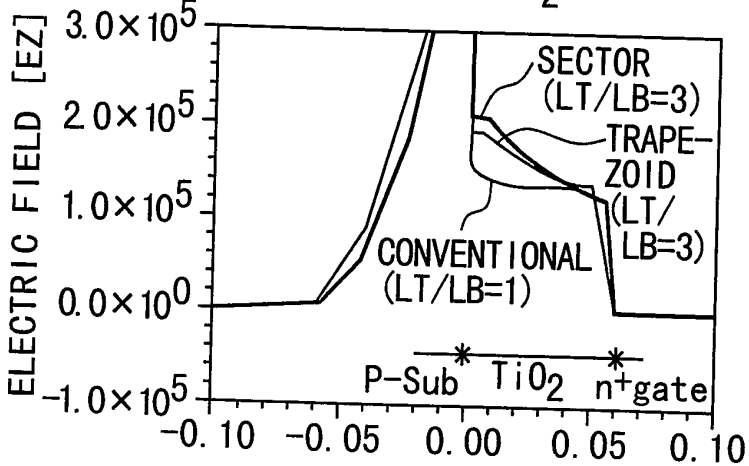


FIG. 9D (b-1) Vg=1V, X=0nm

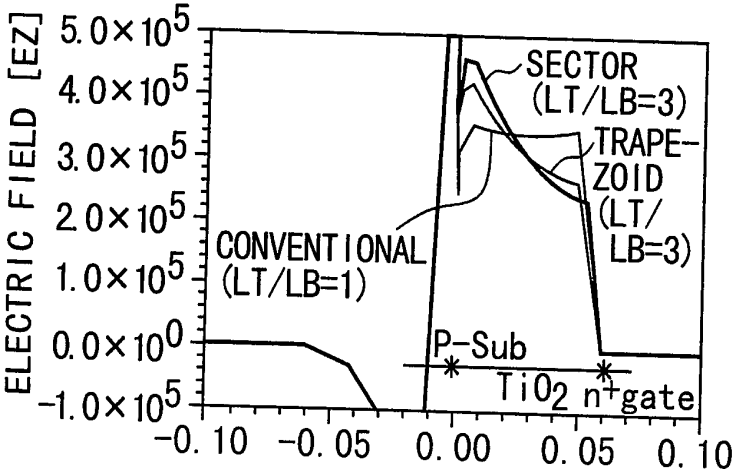
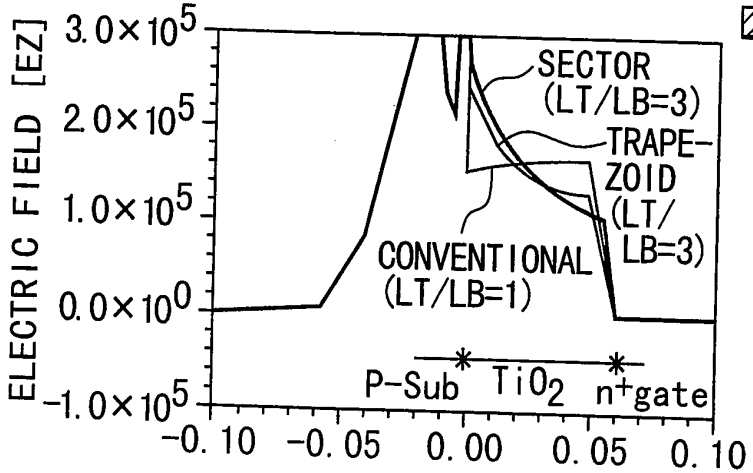


FIG. 9C (a-2) Vg=3V, X=20nm



(b-2) Vg=1V, X=20nm

FIG. 9E

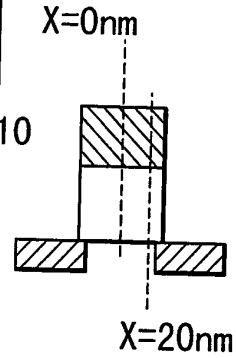


FIG. 9A

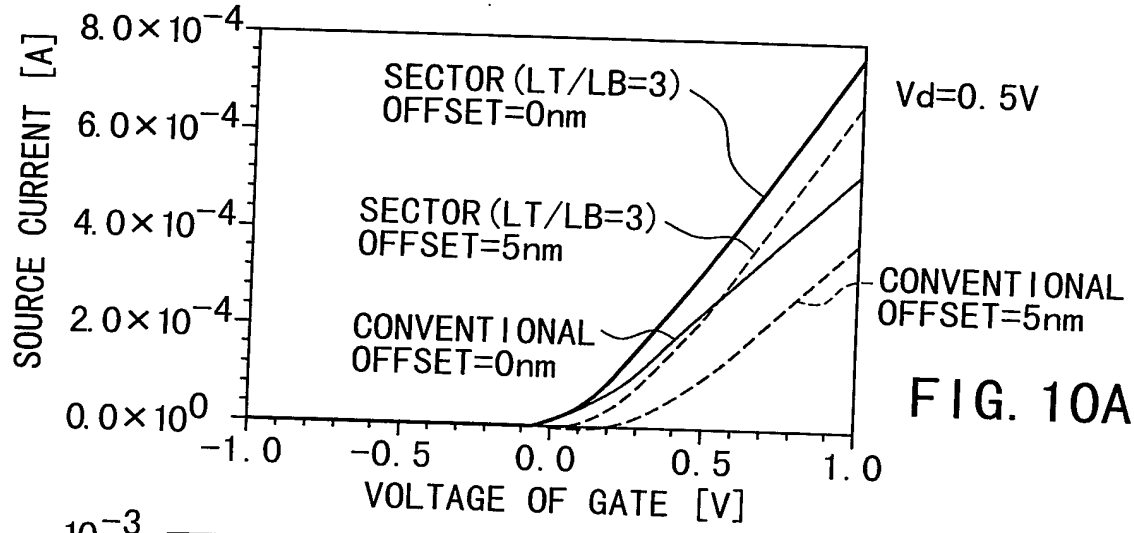


FIG. 10A

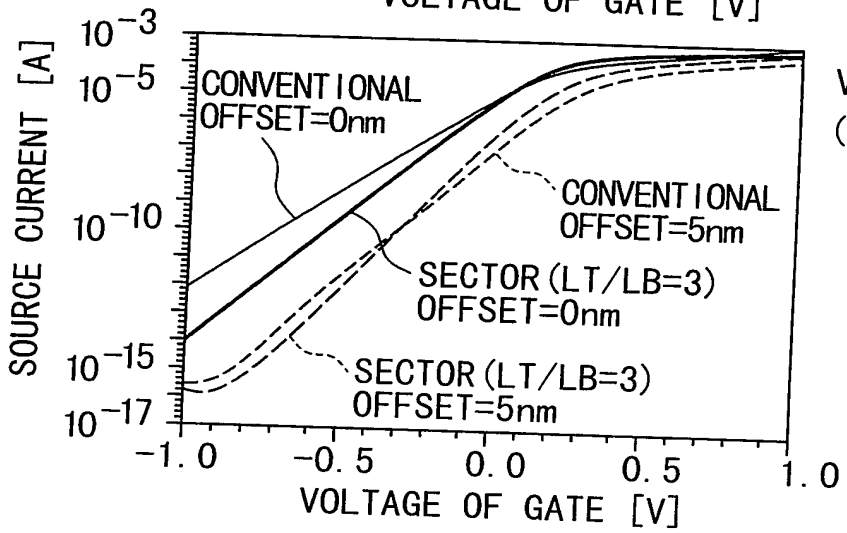


FIG. 10B

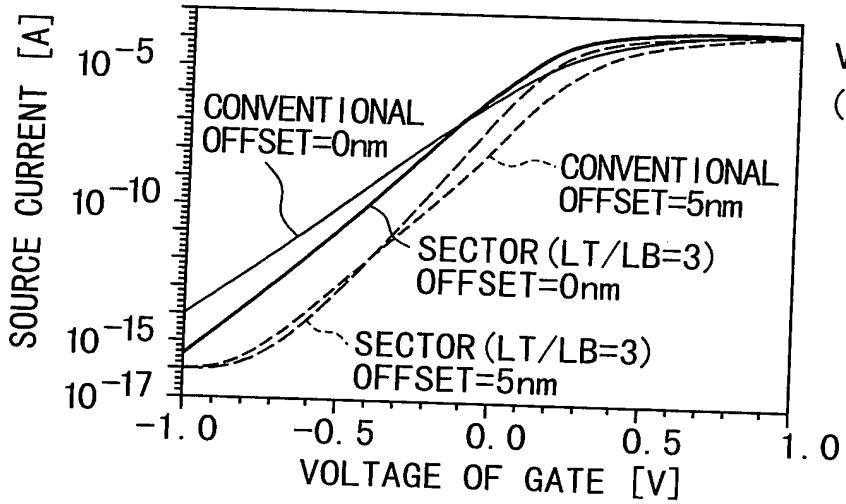


FIG. 10C

OFFSET DEPENDENCY OF Vg=Ids CHARACTERISITIC
(Tef=3.0nm(TiO_2), T=60nm, LB=50nm, εr=80)

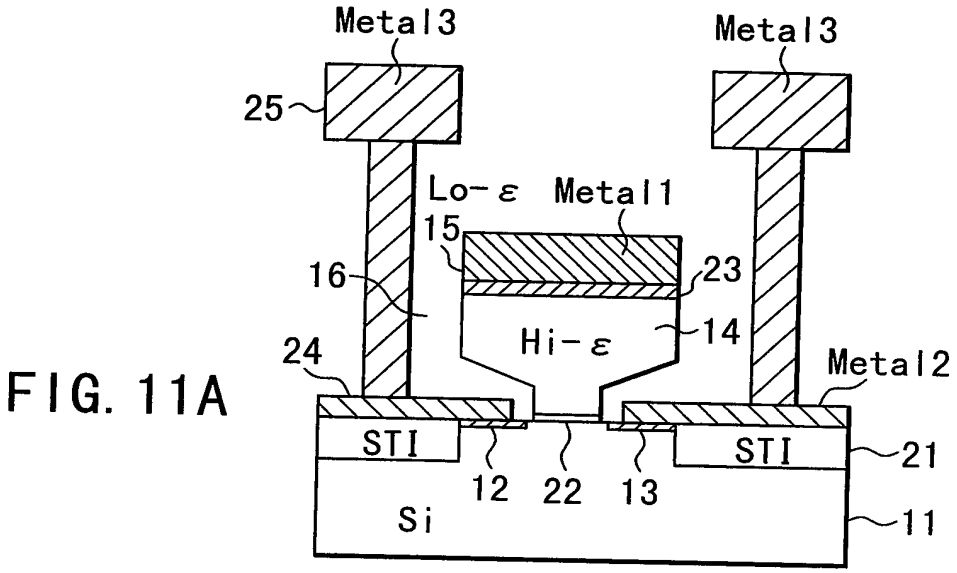


FIG. 11A

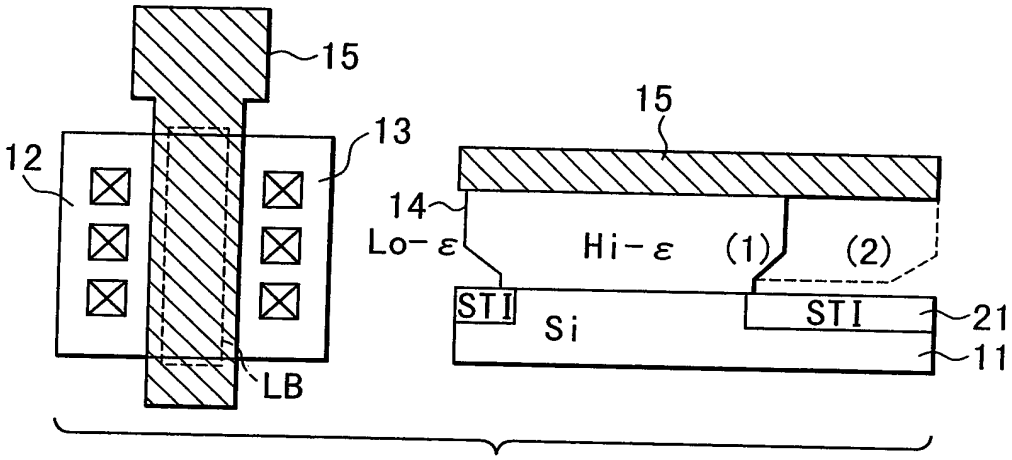


FIG. 11B

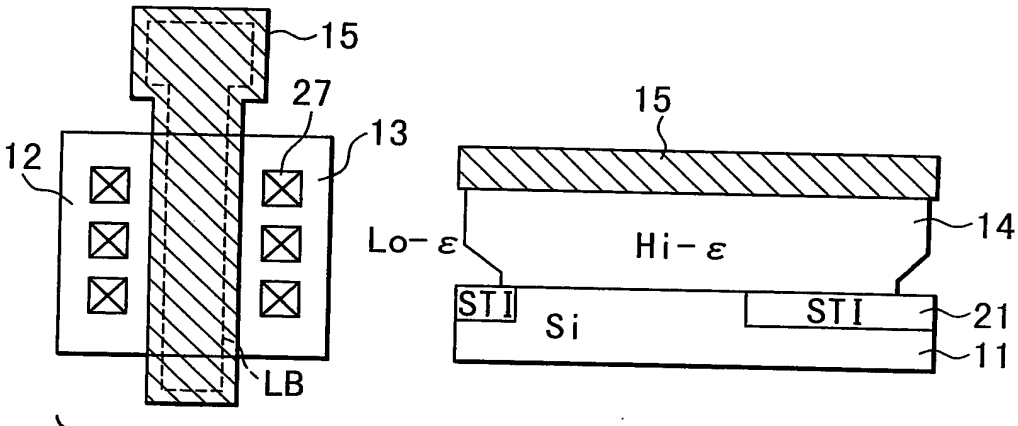
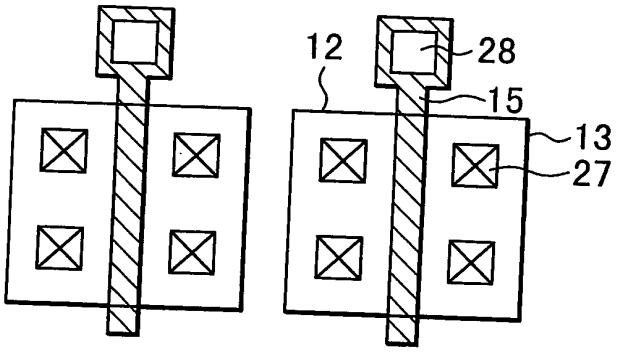
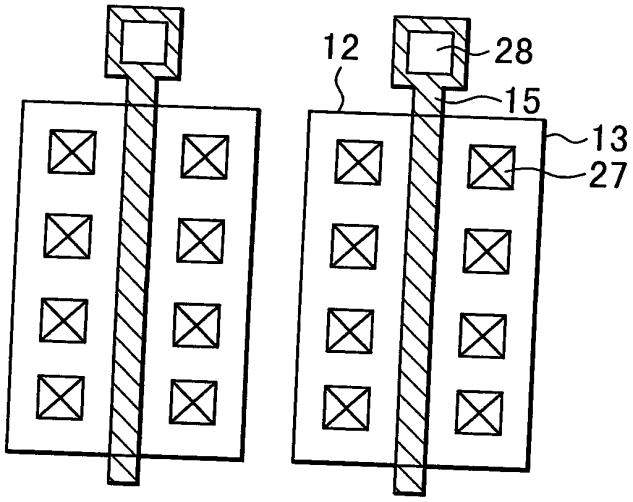


FIG. 11C



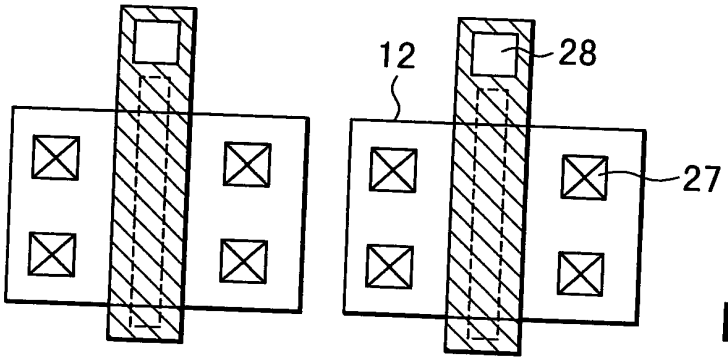
CONVENTIONAL
(W=1)

FIG. 12A
(PRIOR ART)



CONVENTIONAL
(W=1.8)

FIG. 12B
(PRIOR ART)



PRESENT
INVENTION
(W=1)

FIG. 12C

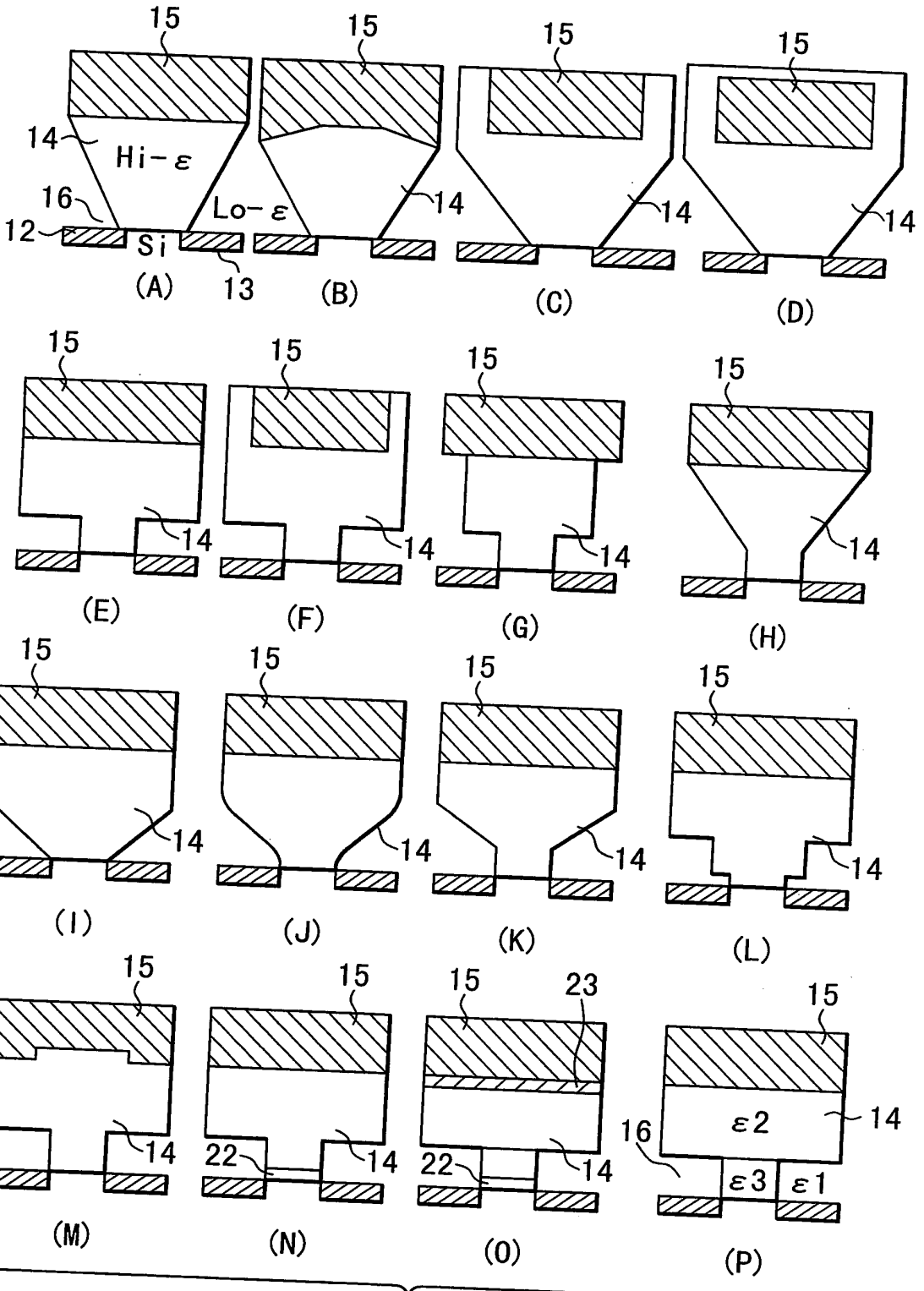


FIG. 13

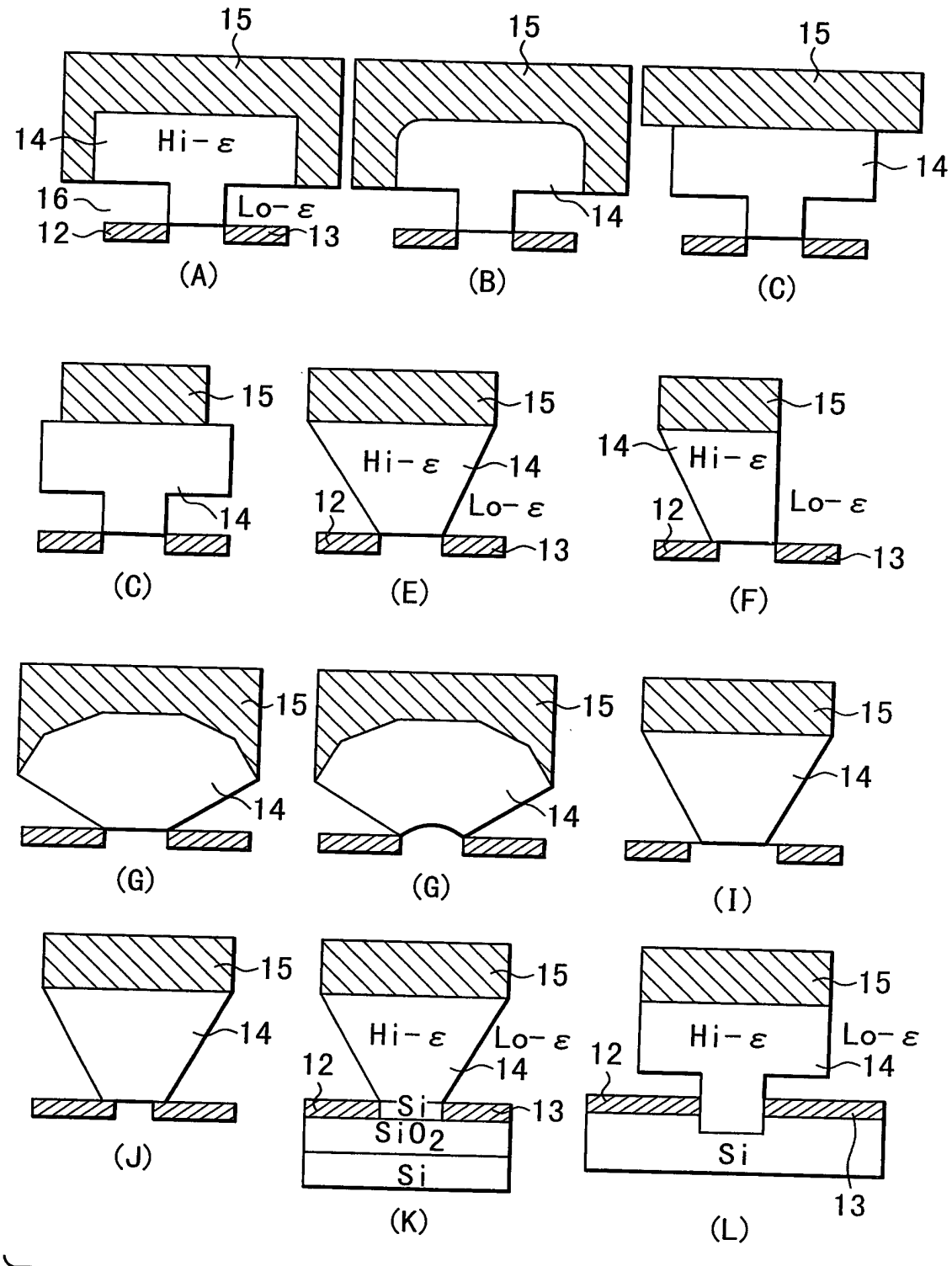


FIG. 14

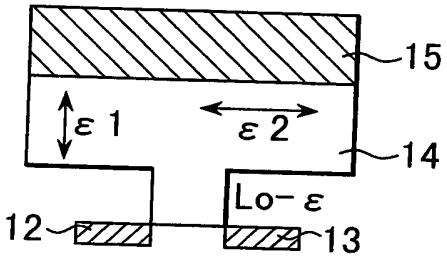


FIG. 15A

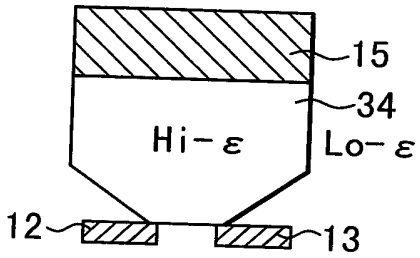


FIG. 15B

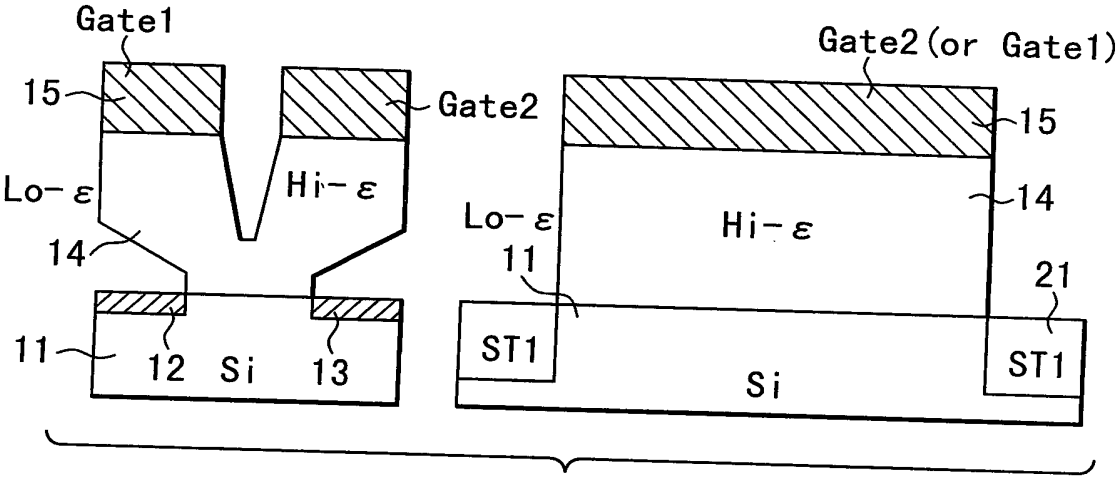


FIG. 15C

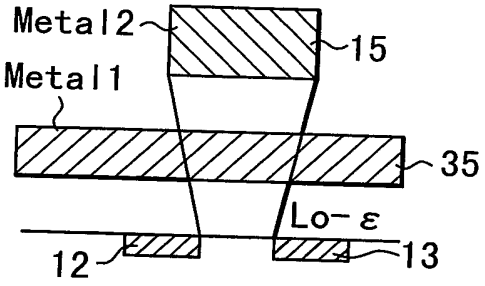


FIG. 15D

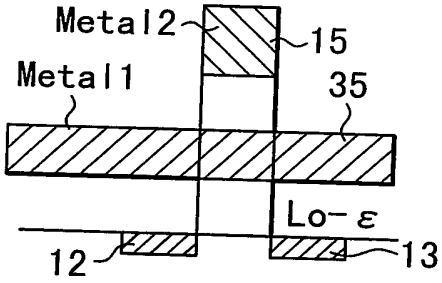


FIG. 15E

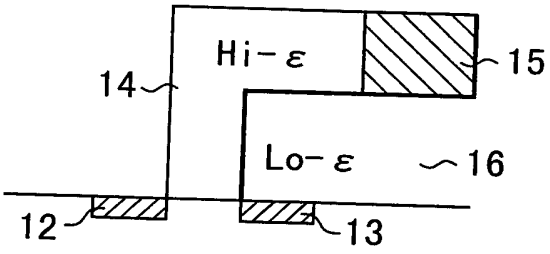


FIG. 15F

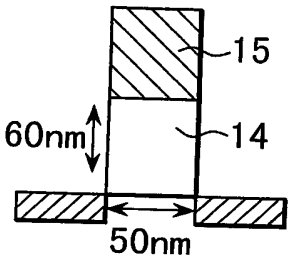


FIG. 16A

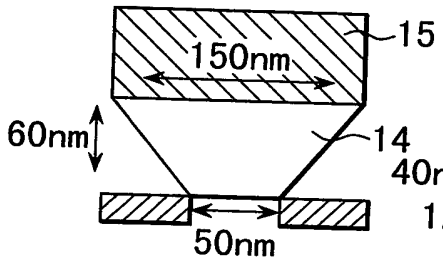


FIG. 16B

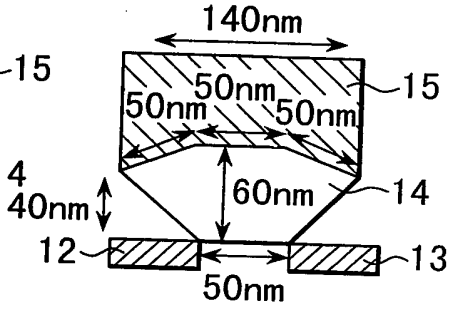


FIG. 16C

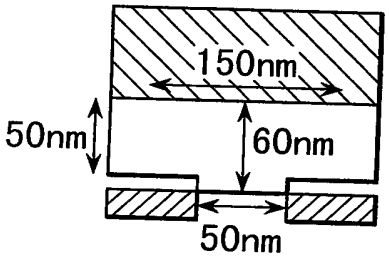


FIG. 16D

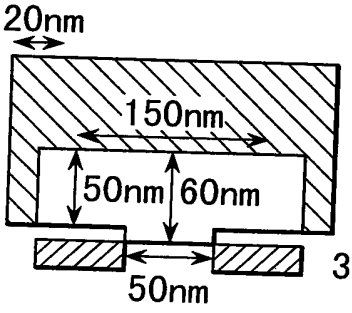


FIG. 16E

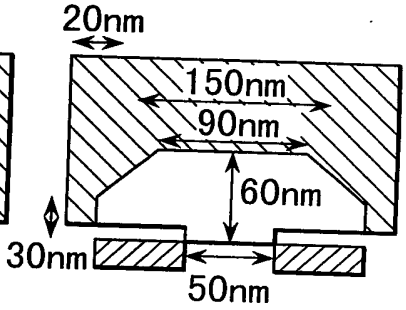


FIG. 16F

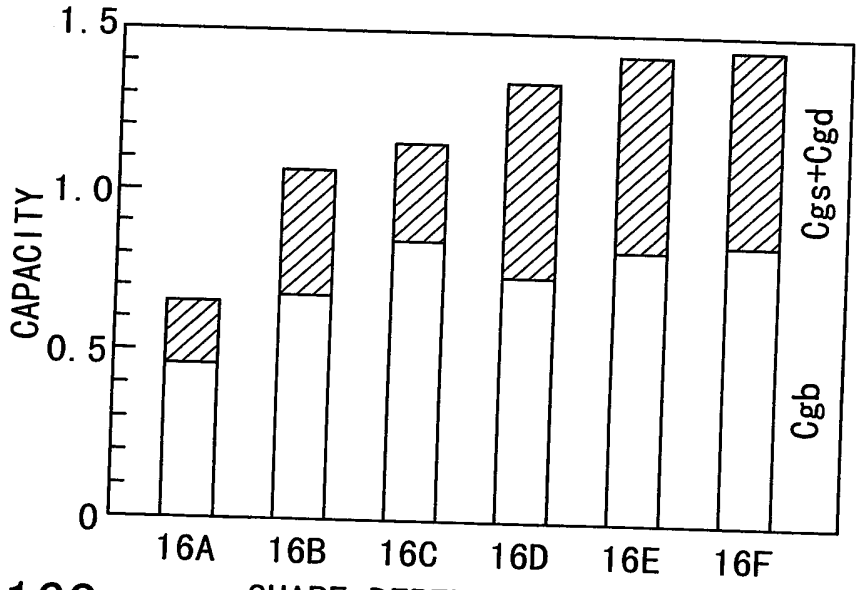
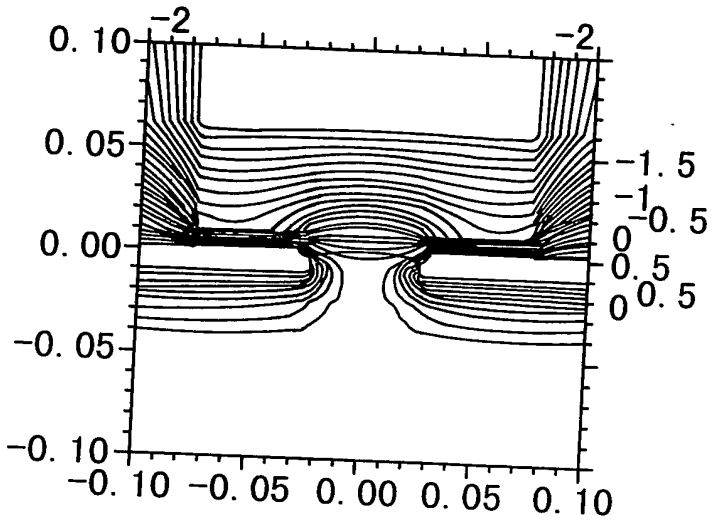


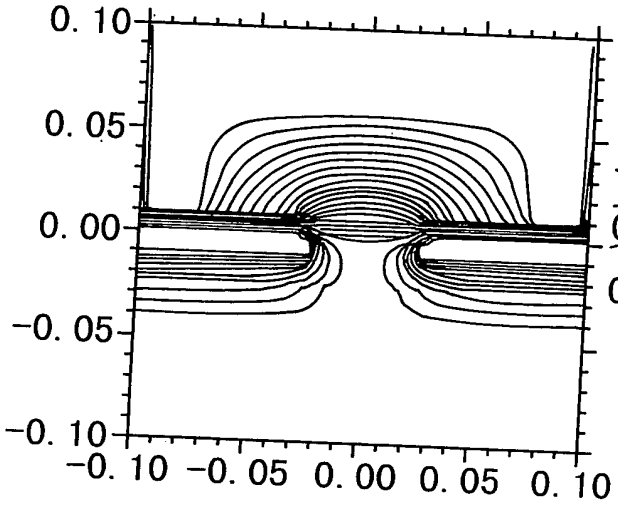
FIG. 16G

SHAPE DEPENDENCY OF EACH CAPACITY COMPONENT
Tef=3.0nm $\varepsilon r=80(TiO_2)$



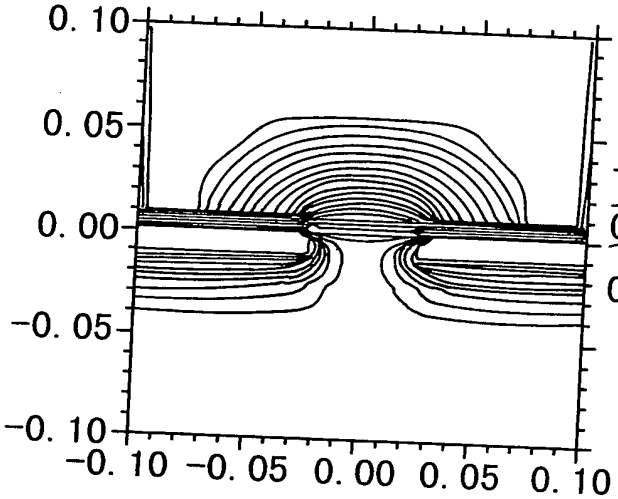
REVERSE-CONVEX TYPE
(LT/LB=3)

FIG. 17A



THICKNESS FILM
STACK TYPE

FIG. 17B



THICKNESS FILM
STACK SECTOR

FIG. 17C

EQUIPOTENTIAL LINE CHART
(Vg=-3V) Vd=Vs=Vb=0V, 0.1V/div
(T=60nm, (Tef=3nm), LB=50nm, $\varepsilon r=80(TiO_2)$)

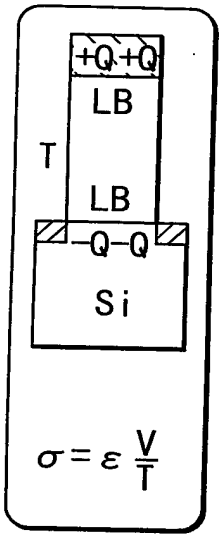


FIG. 18A
(PRIOR ART)

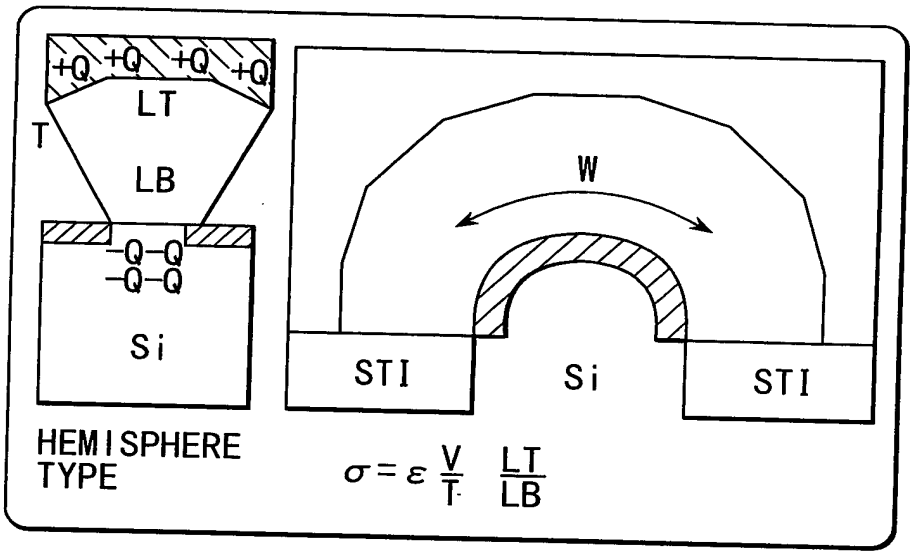


FIG. 18B

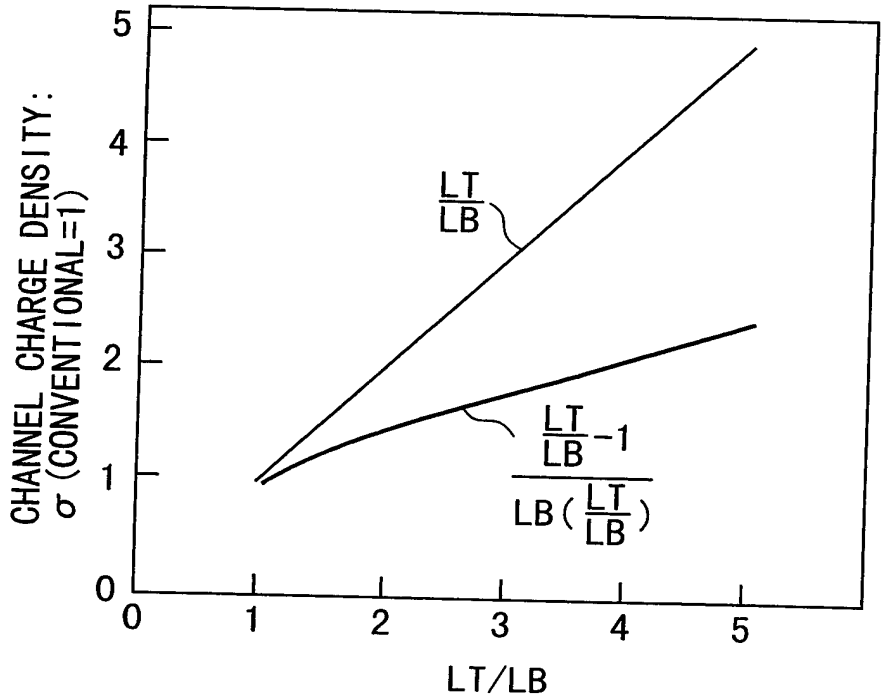


FIG. 18C

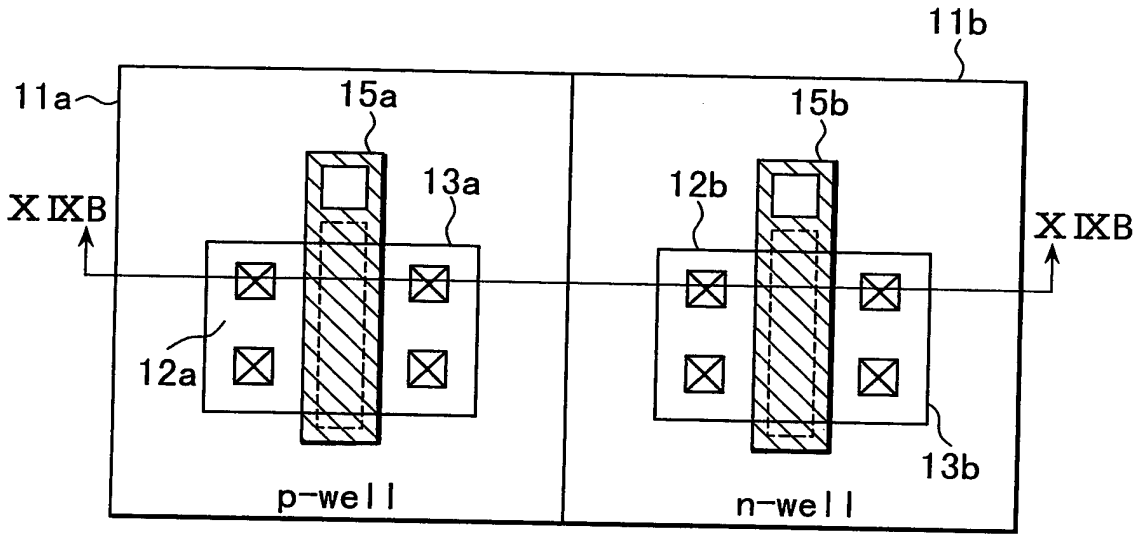


FIG. 19A

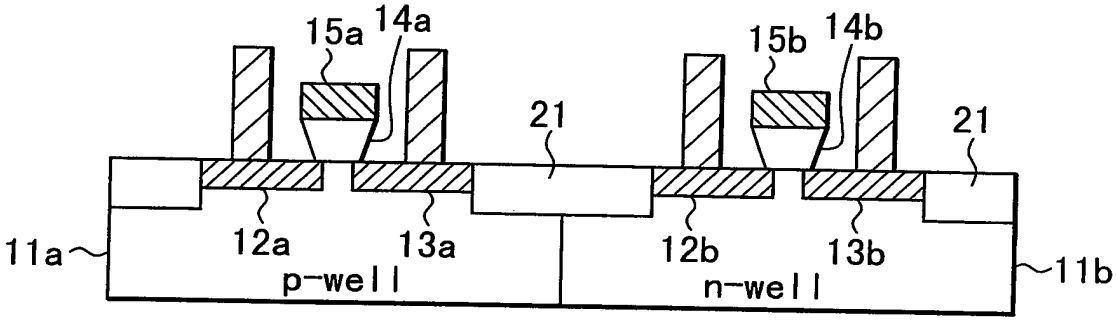


FIG. 19B

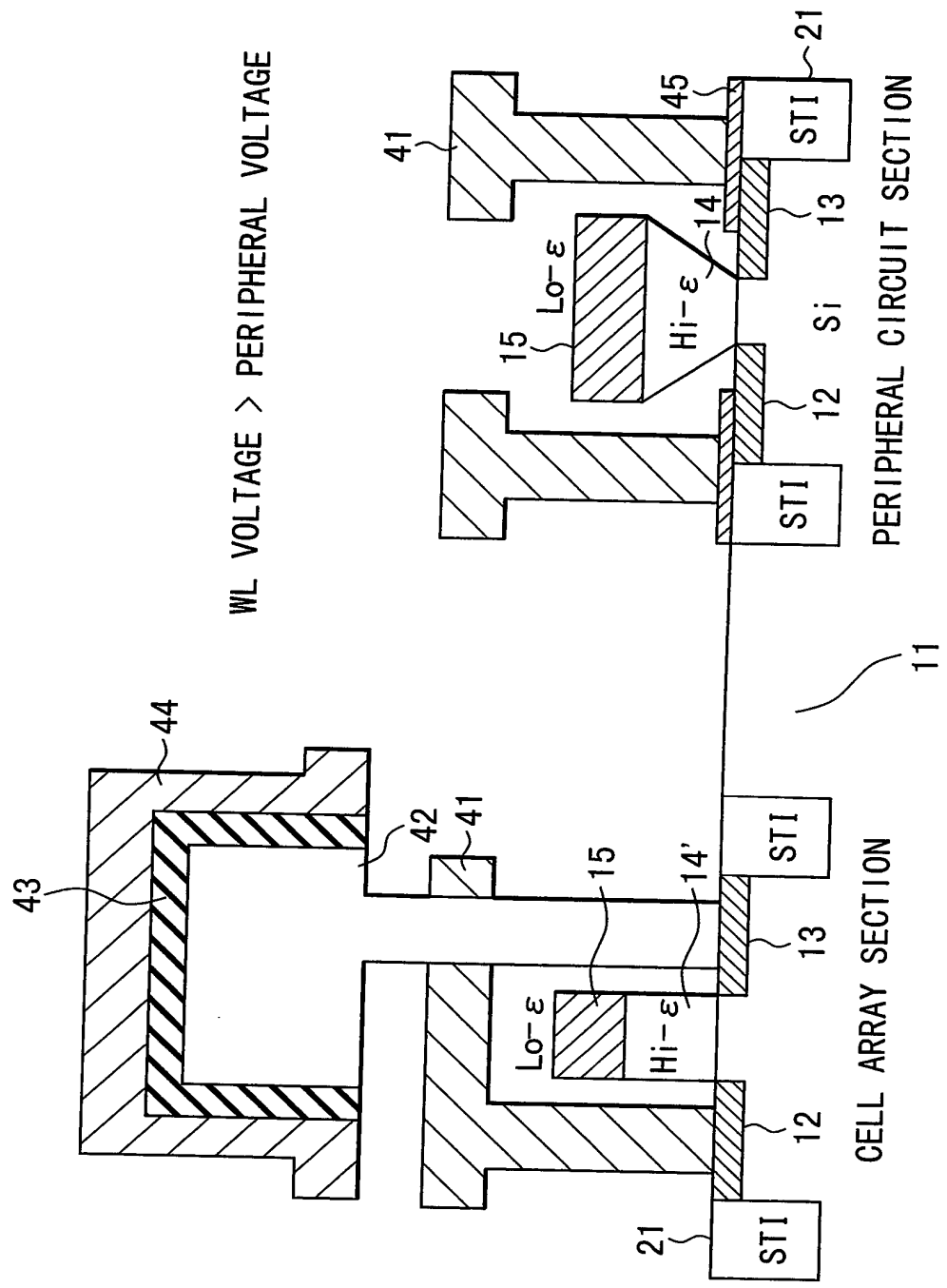


FIG. 20

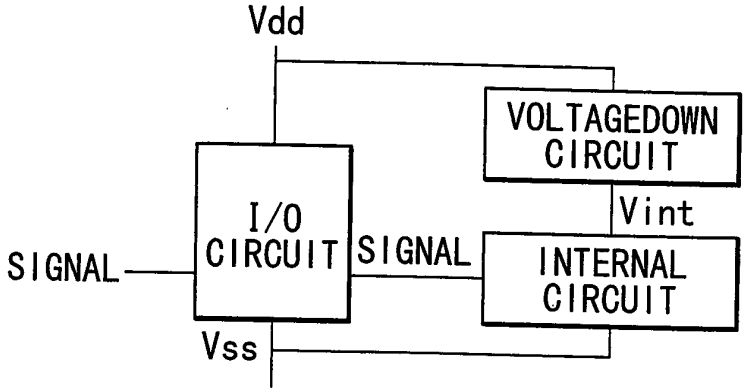


FIG. 21A

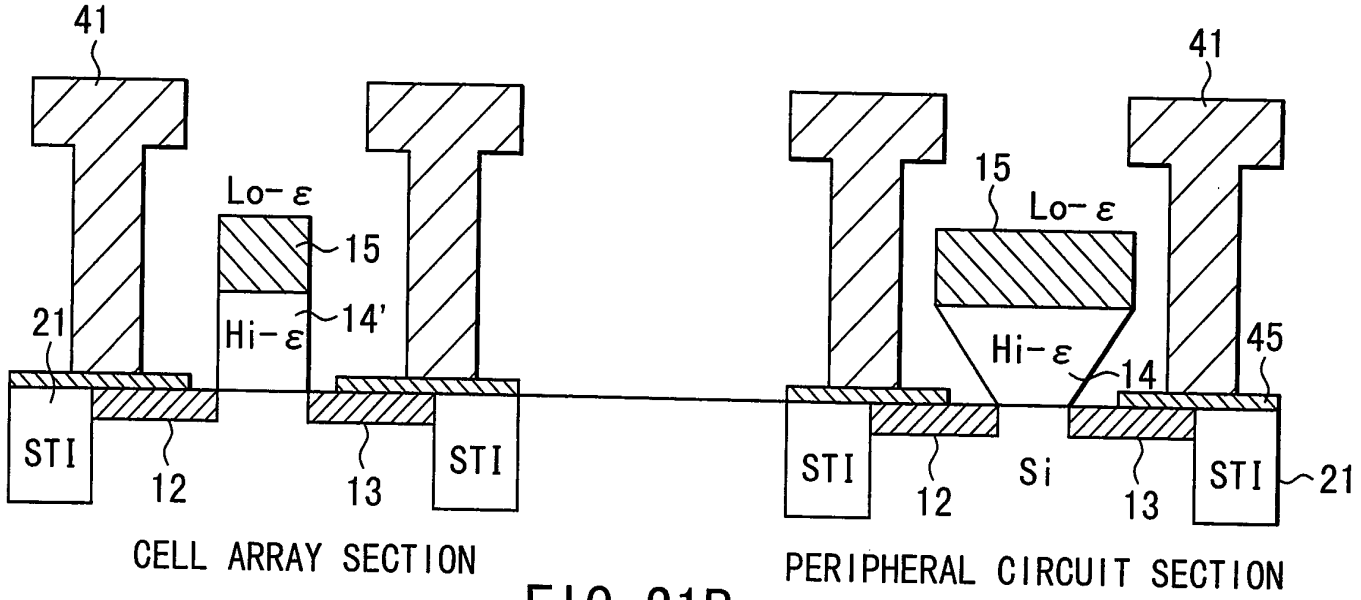


FIG. 21B

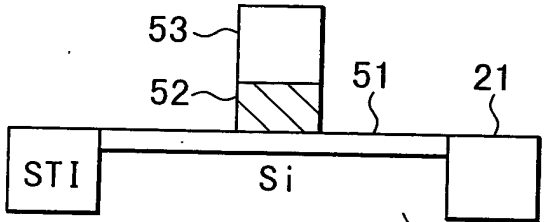


FIG. 22A

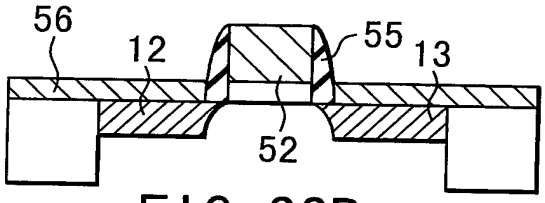


FIG. 22B

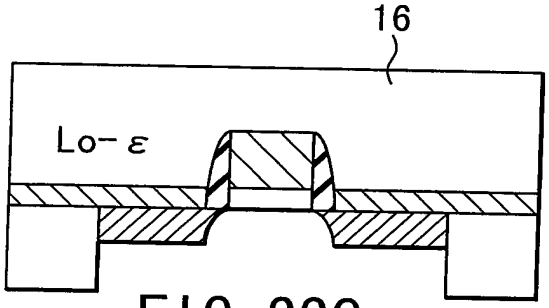


FIG. 22C

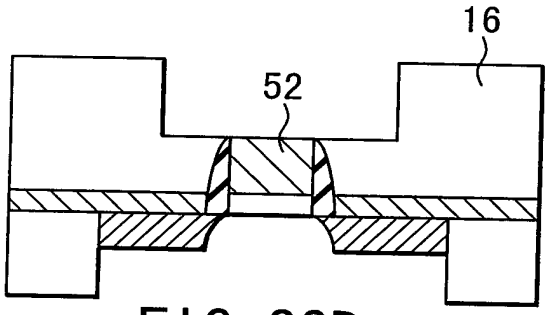


FIG. 22D

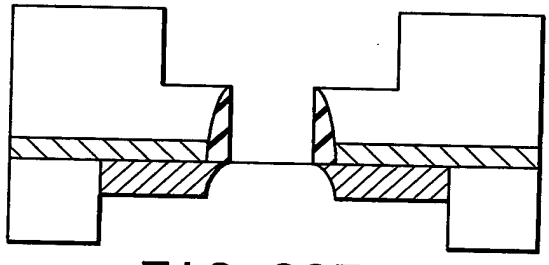


FIG. 22E

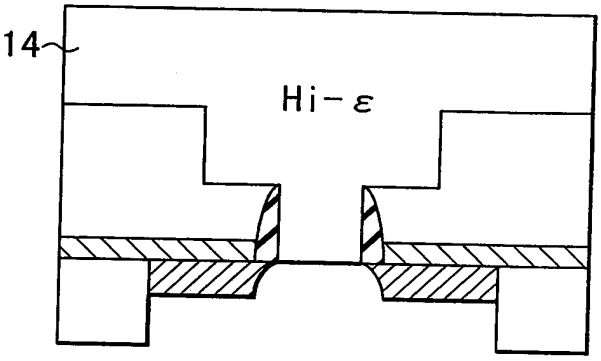


FIG. 22F

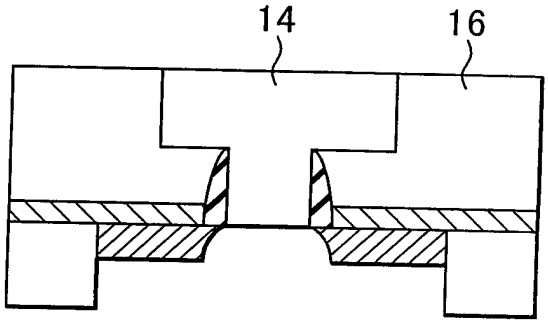


FIG. 22G

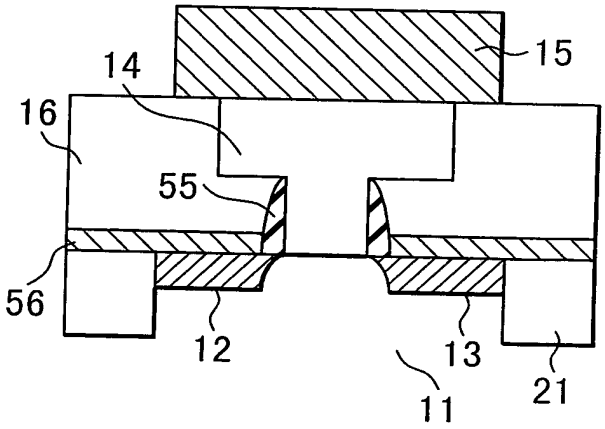


FIG. 22H

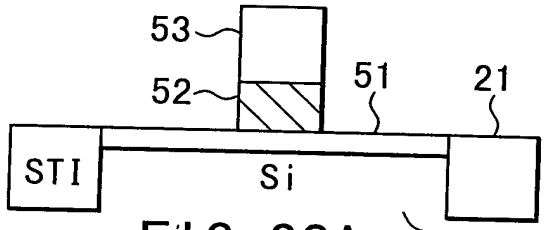


FIG. 23A

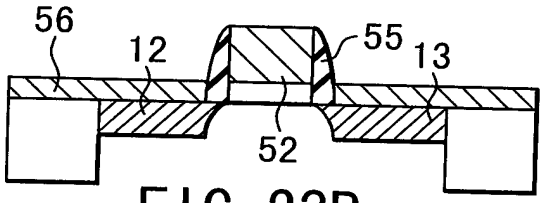


FIG. 23B

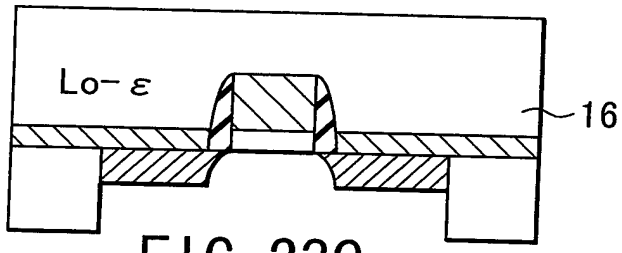


FIG. 23C

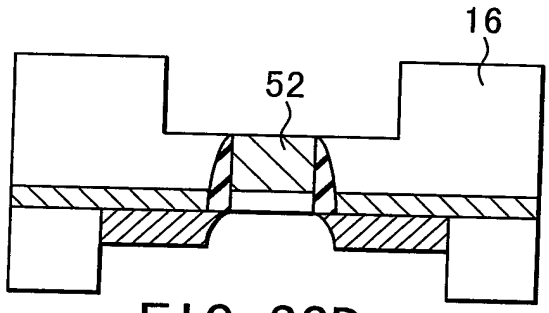


FIG. 23D

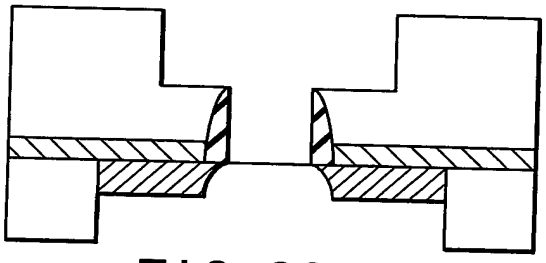


FIG. 23E

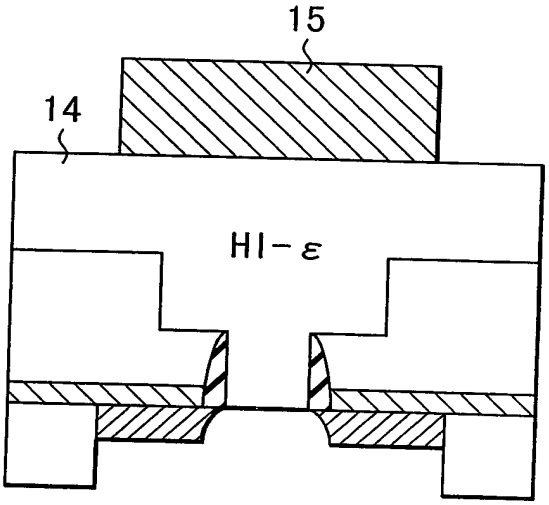


FIG. 23F

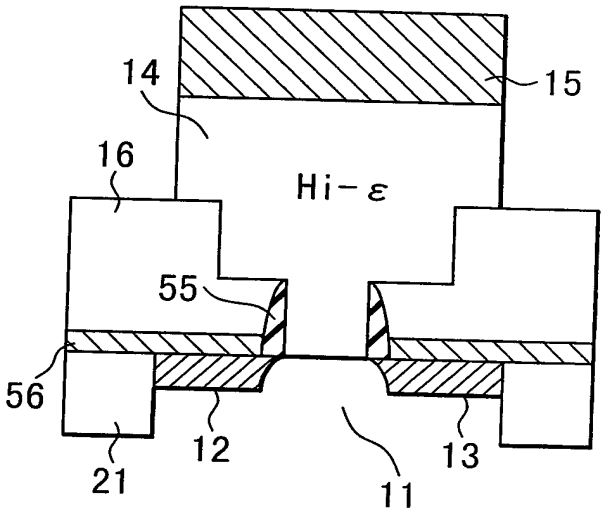


FIG. 23G

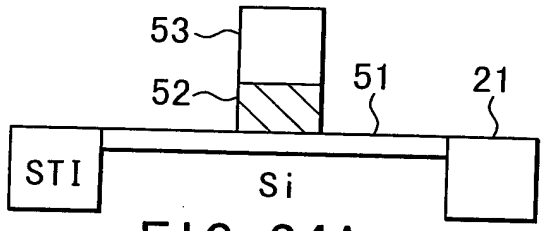


FIG. 24A

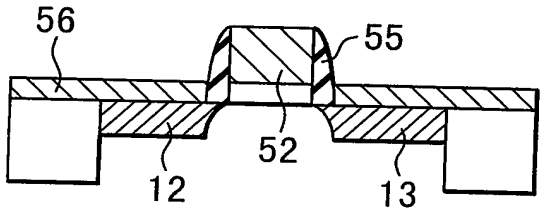


FIG. 24B

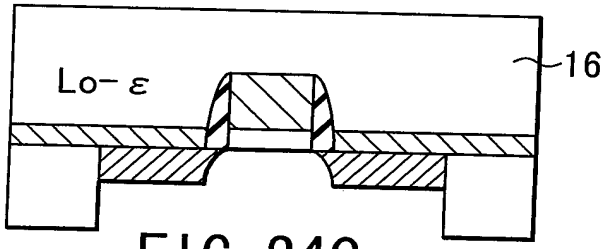


FIG. 24C

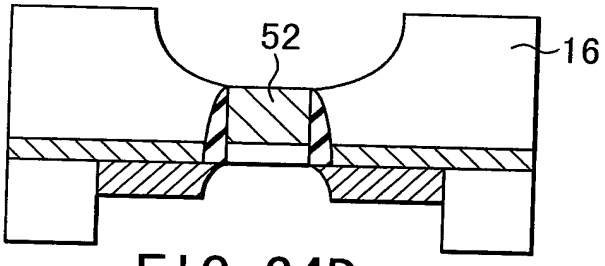


FIG. 24D

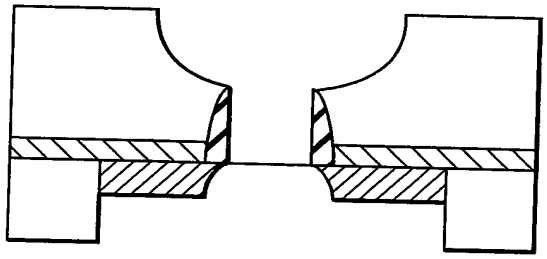


FIG. 24E

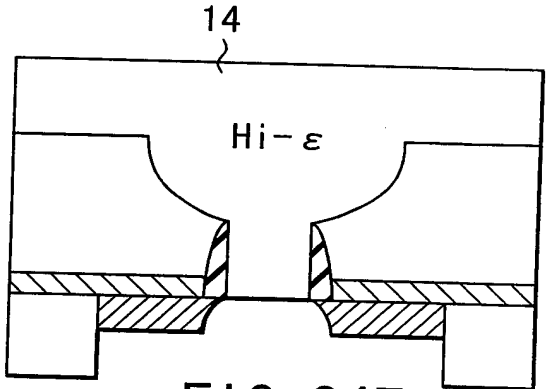


FIG. 24F

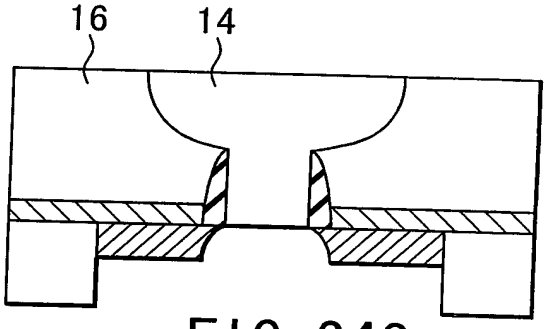


FIG. 24G

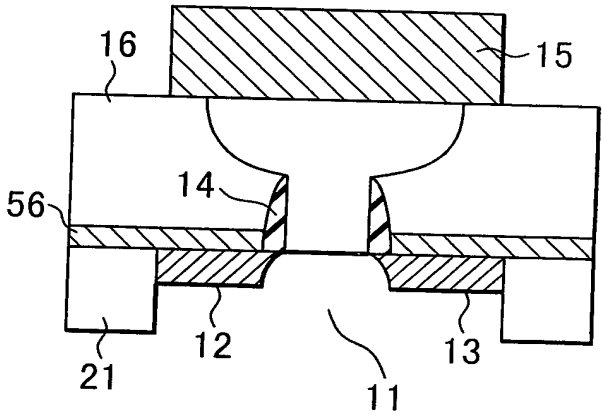


FIG. 24H

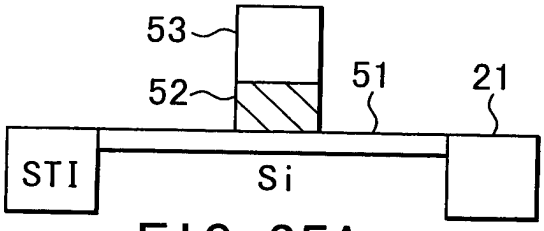


FIG. 25A

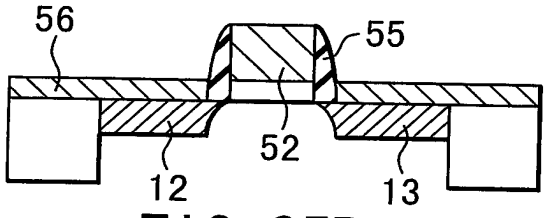


FIG. 25B

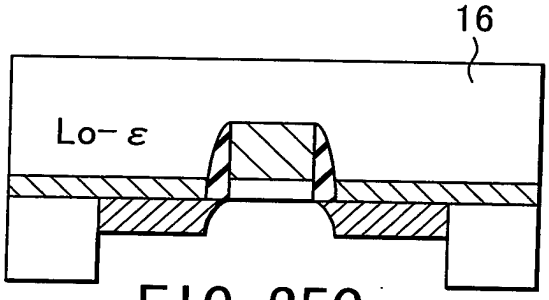


FIG. 25C

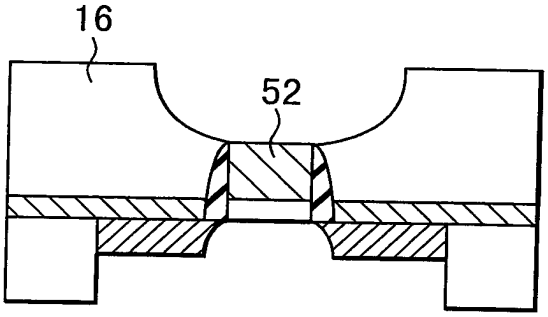


FIG. 25D

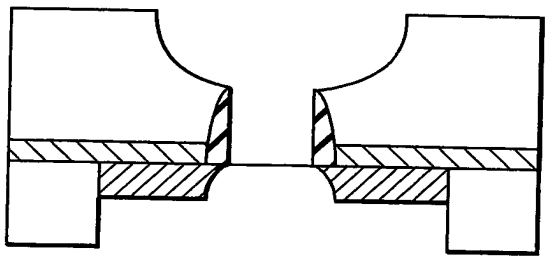


FIG. 25E

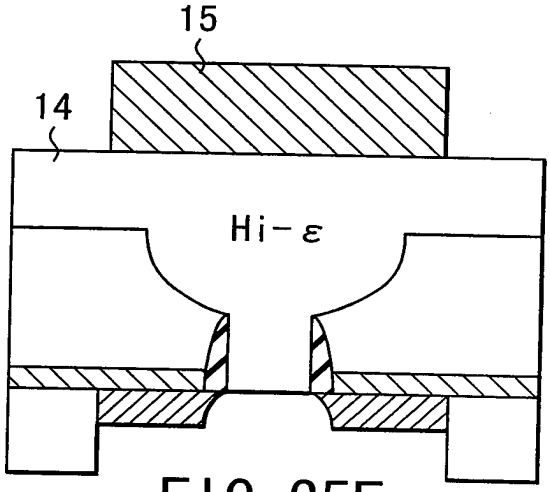


FIG. 25F

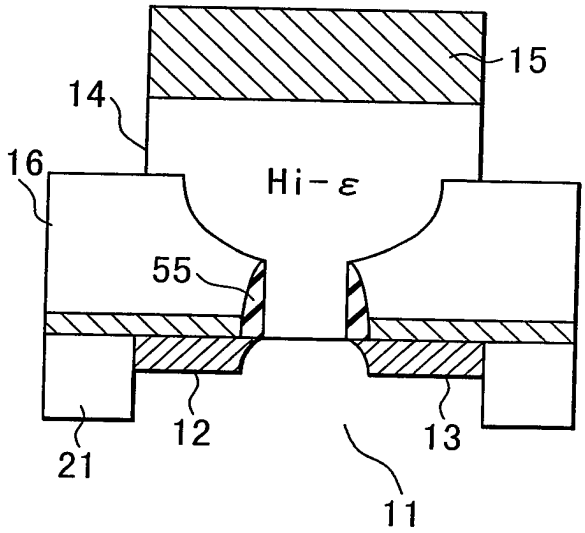


FIG. 25G

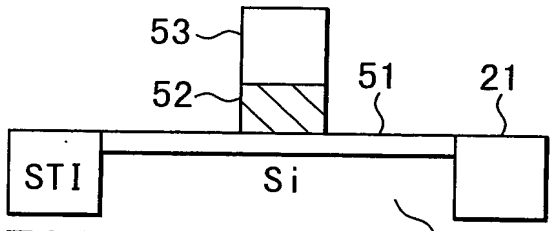


FIG. 26A

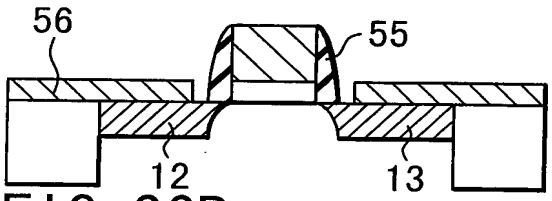


FIG. 26B

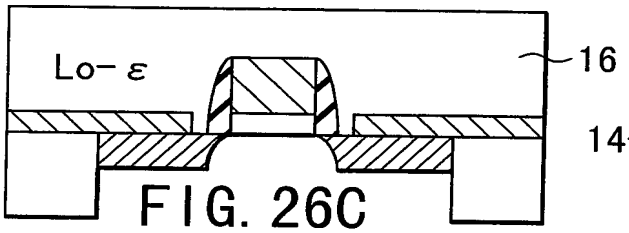


FIG. 26C

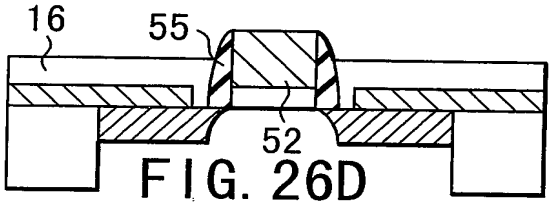


FIG. 26D

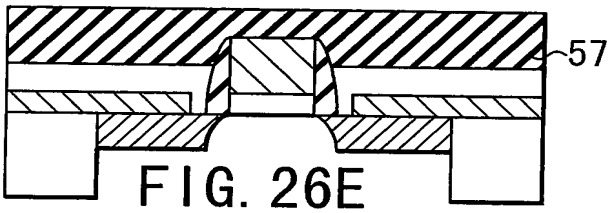


FIG. 26E

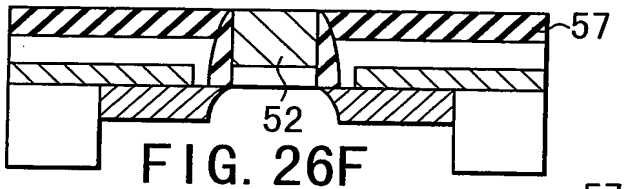


FIG. 26F

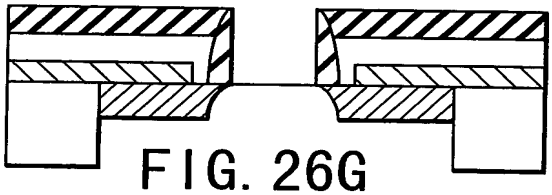


FIG. 26G

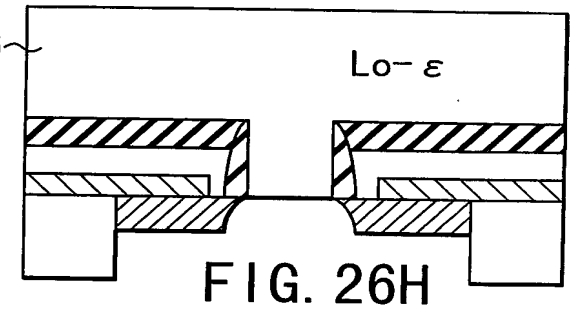


FIG. 26H

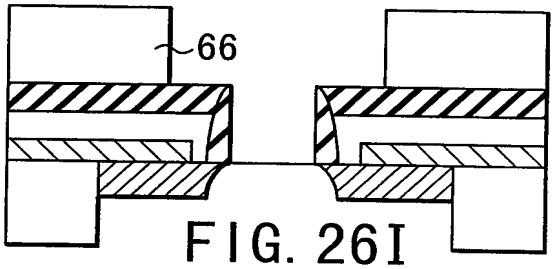


FIG. 26I

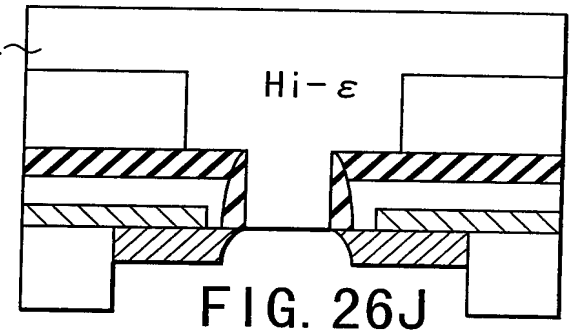


FIG. 26J

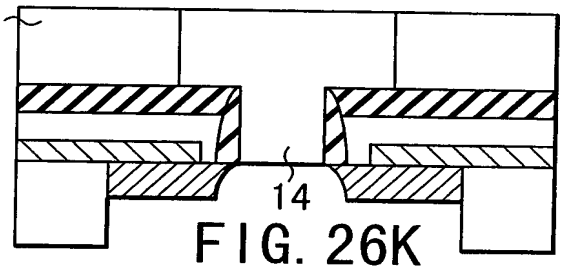


FIG. 26K

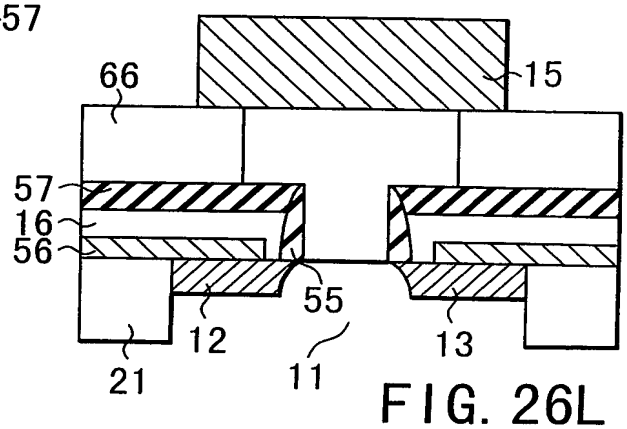


FIG. 26L

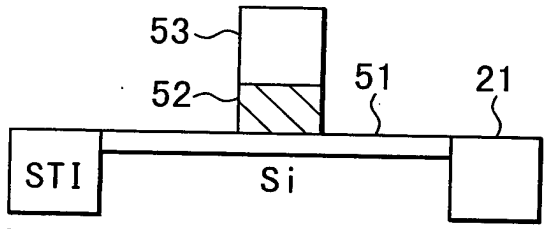


FIG. 27A

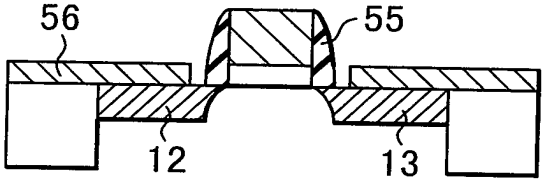


FIG. 27B

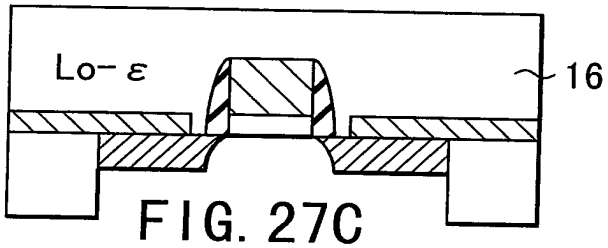


FIG. 27C

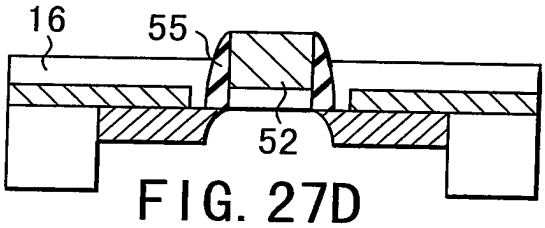


FIG. 27D

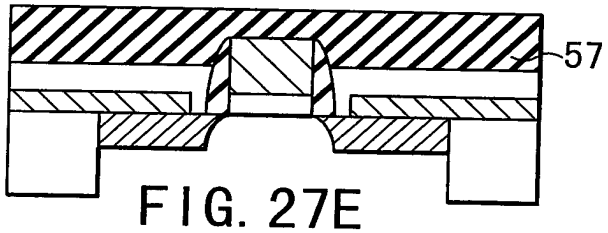


FIG. 27E

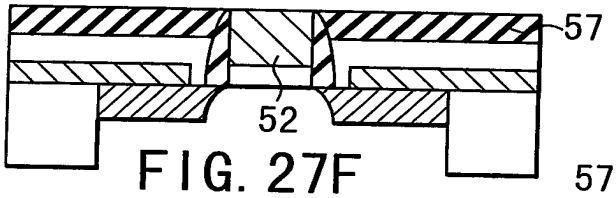


FIG. 27F

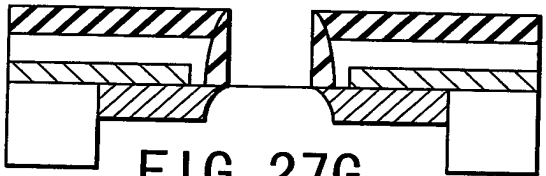


FIG. 27G

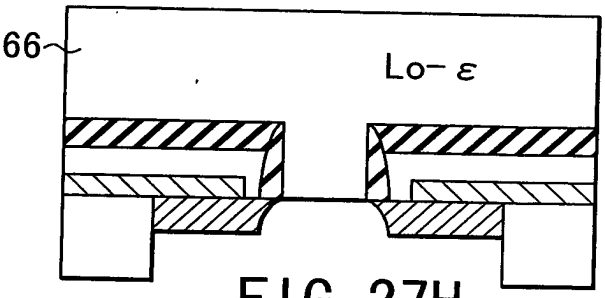


FIG. 27H

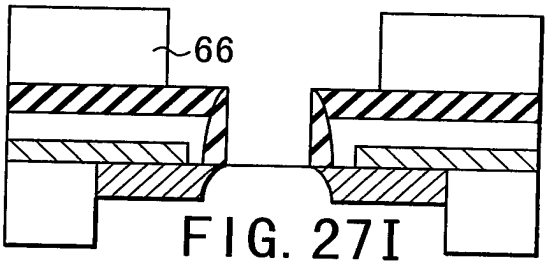


FIG. 27I

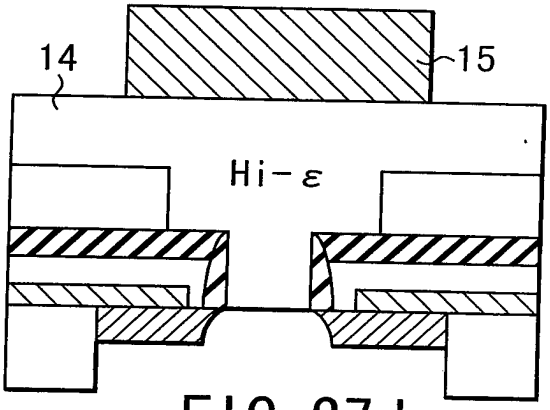


FIG. 27J

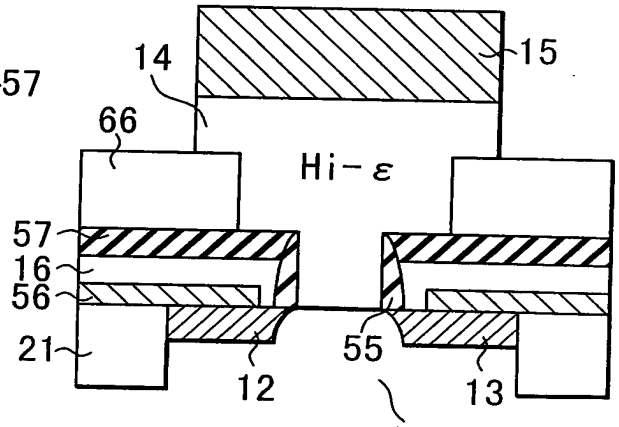


FIG. 27K

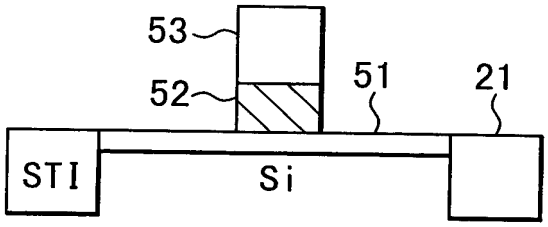


FIG. 28A

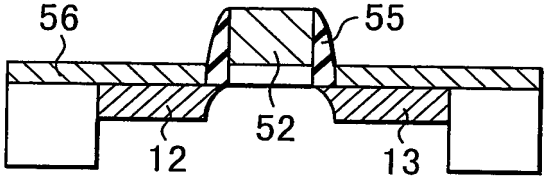


FIG. 28B

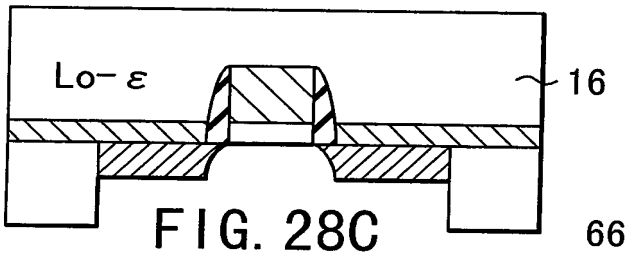


FIG. 28C

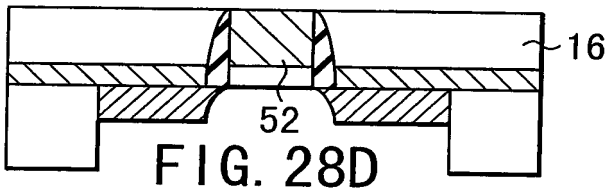


FIG. 28D

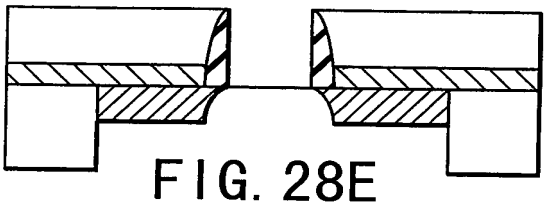


FIG. 28E

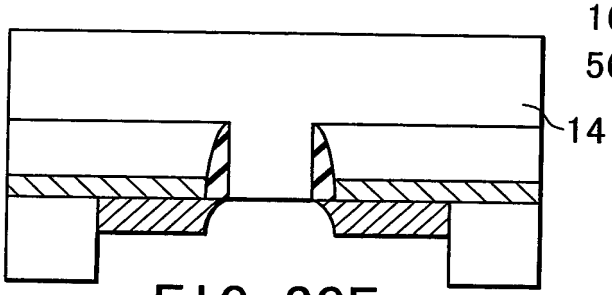


FIG. 28F

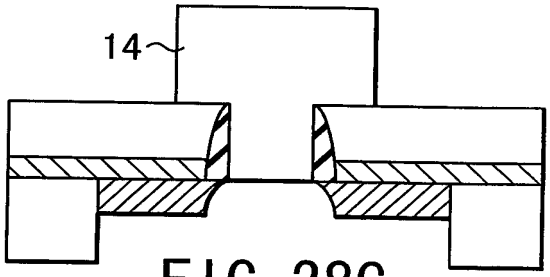


FIG. 28G

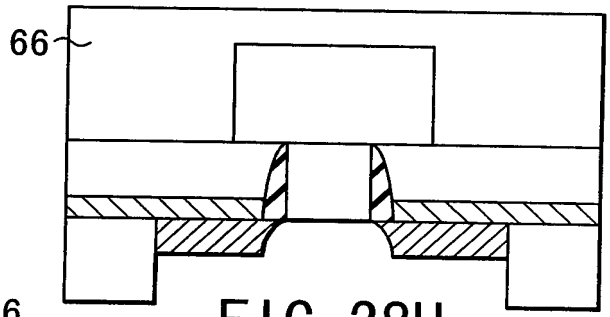


FIG. 28H

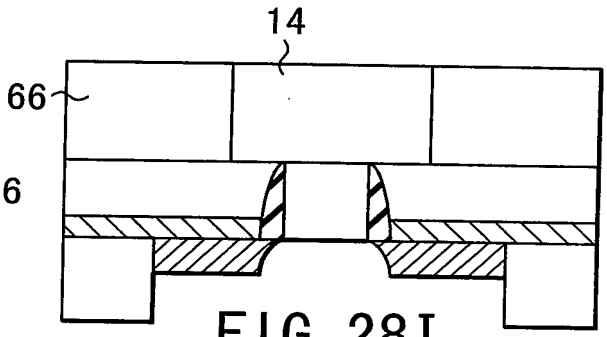


FIG. 28I

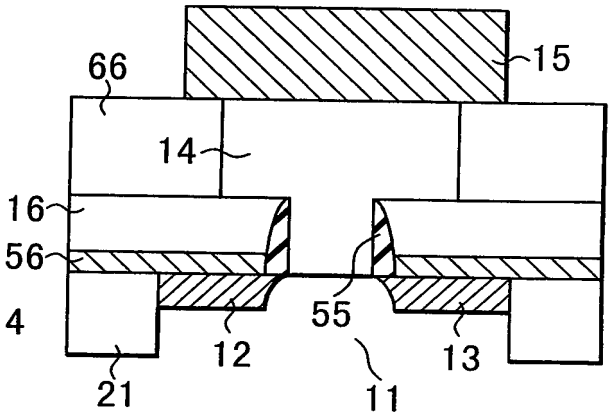


FIG. 28J

APPROVED BY DRAFTSMAN	O.G. FIG.	
	CLASS	SUBCLASS

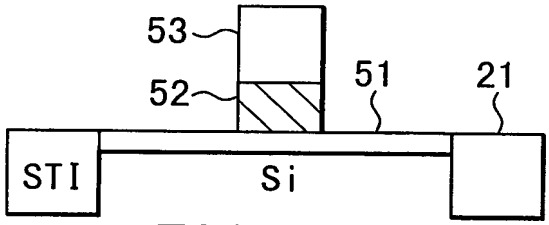


FIG. 29A

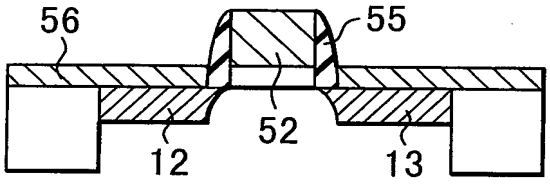


FIG. 29B

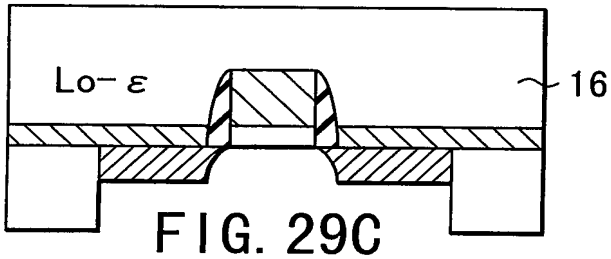


FIG. 29C

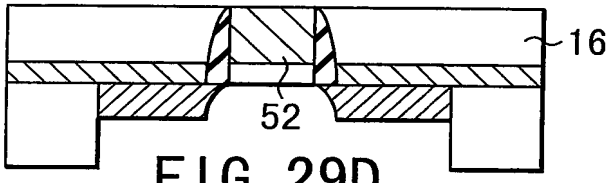


FIG. 29D

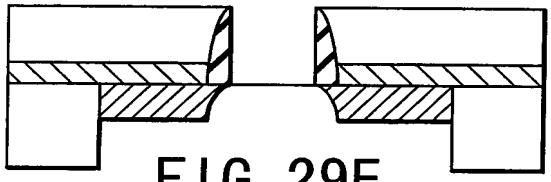


FIG. 29E

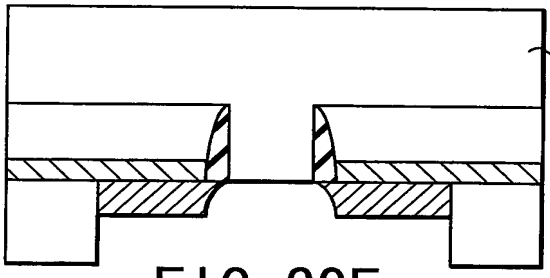


FIG. 29F

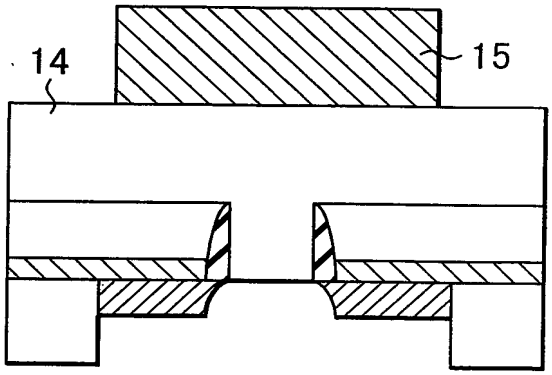


FIG. 29G

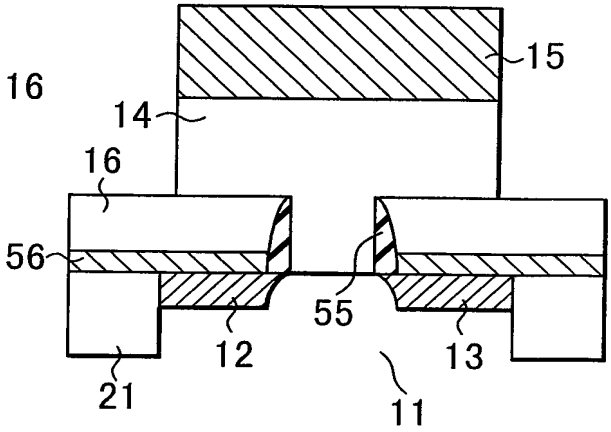


FIG. 29H

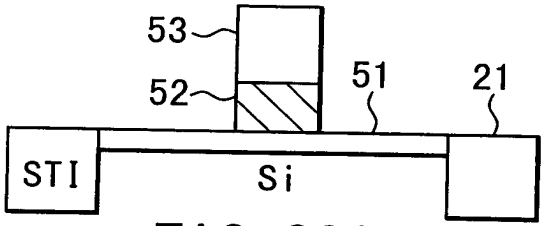


FIG. 30A

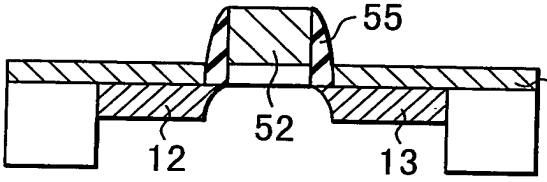


FIG. 30B

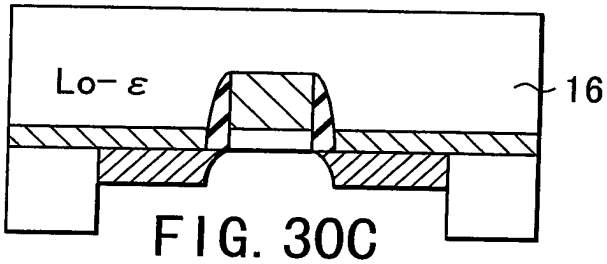


FIG. 30C

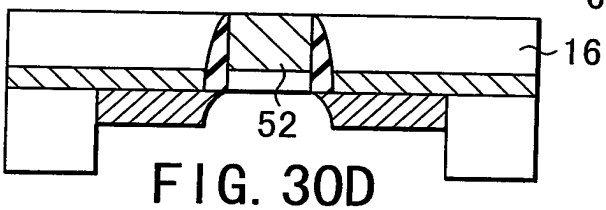


FIG. 30D

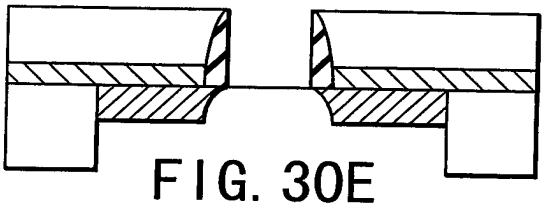


FIG. 30E

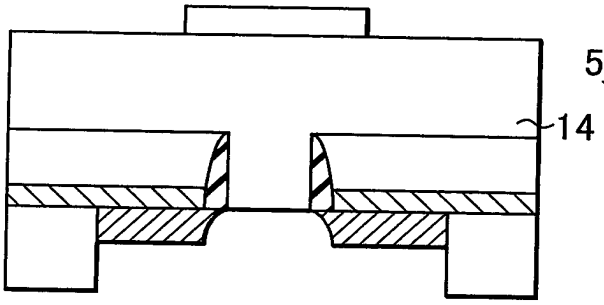


FIG. 30F

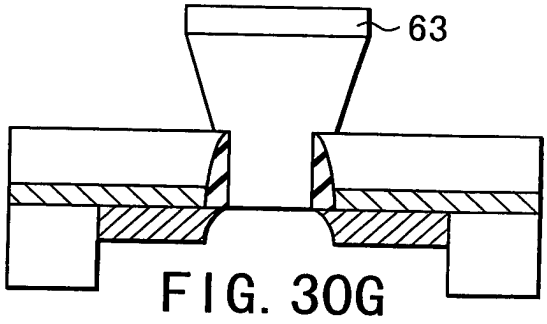


FIG. 30G

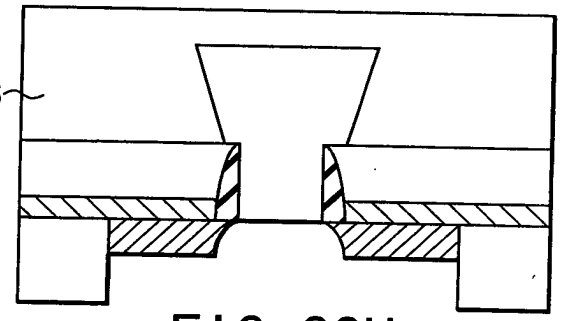


FIG. 30H

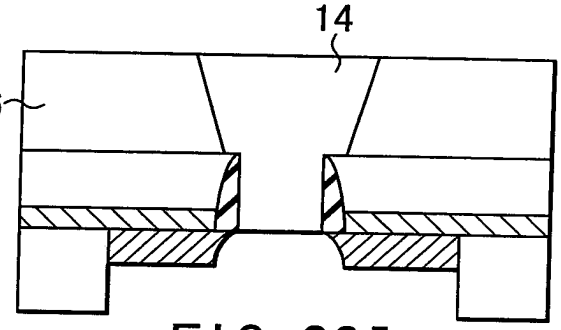


FIG. 30I

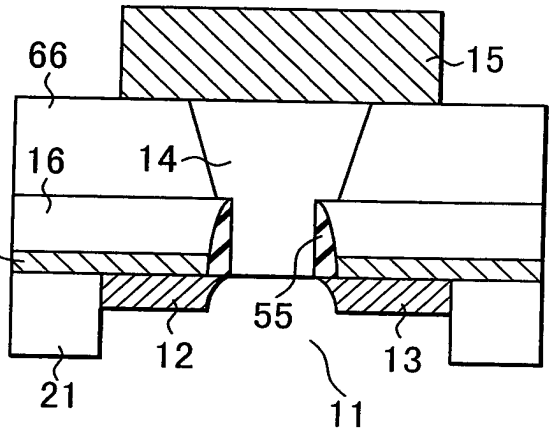


FIG. 30J

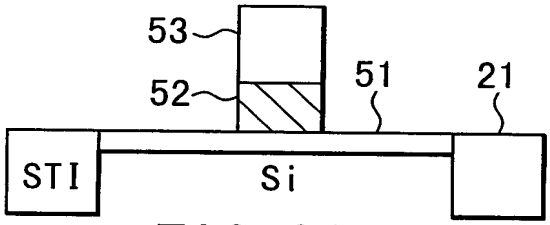


FIG. 31A

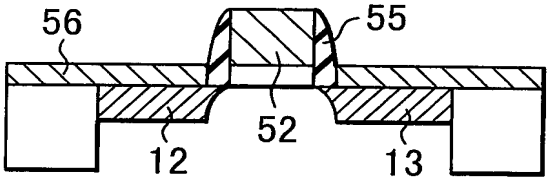


FIG. 31B

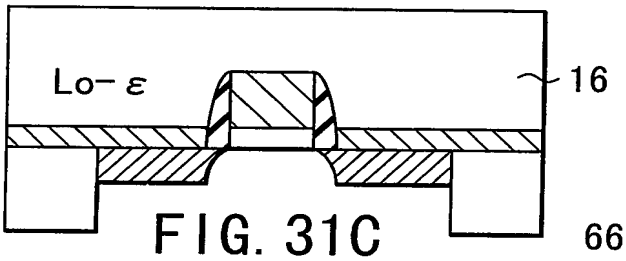


FIG. 31C

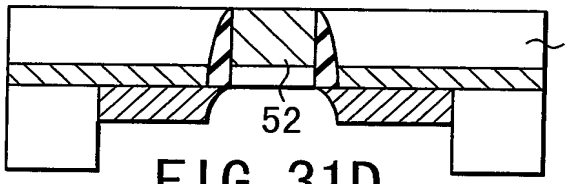


FIG. 31D

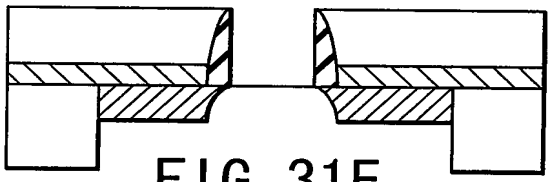


FIG. 31E

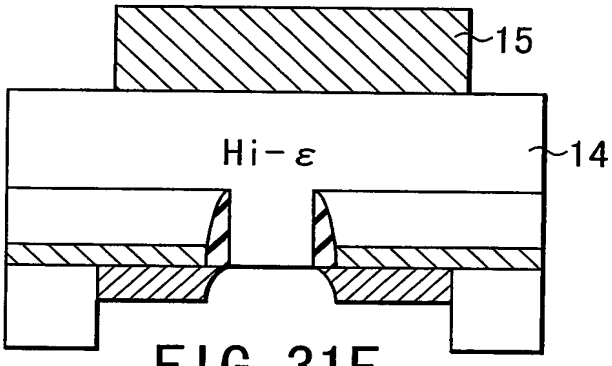


FIG. 31F

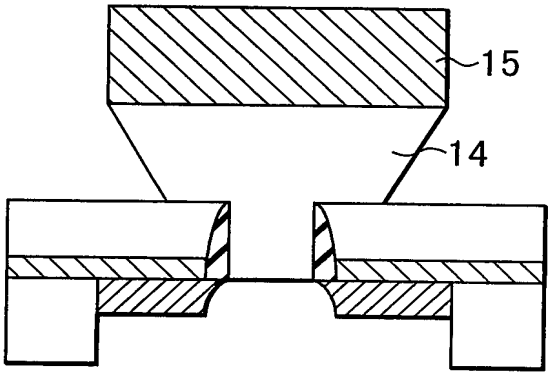


FIG. 31G

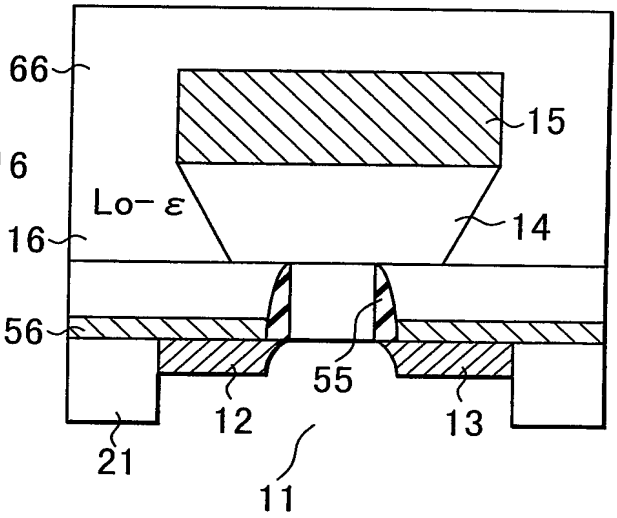


FIG. 31H

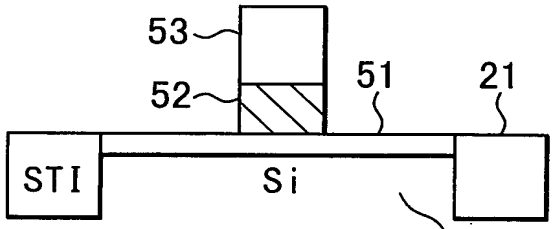


FIG. 32A

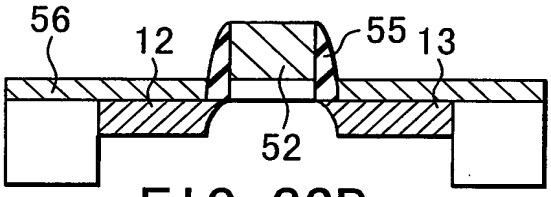


FIG. 32B

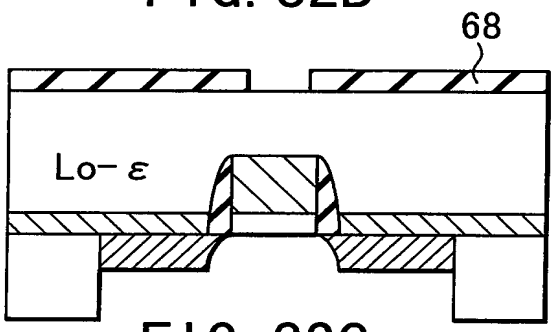


FIG. 32C

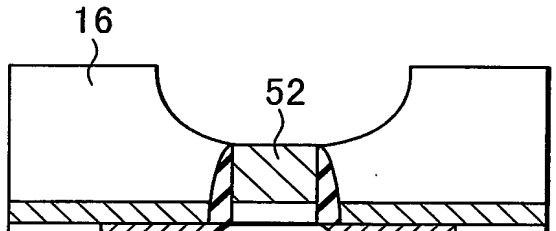


FIG. 32D

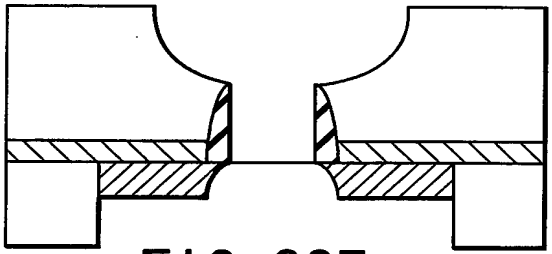


FIG. 32E

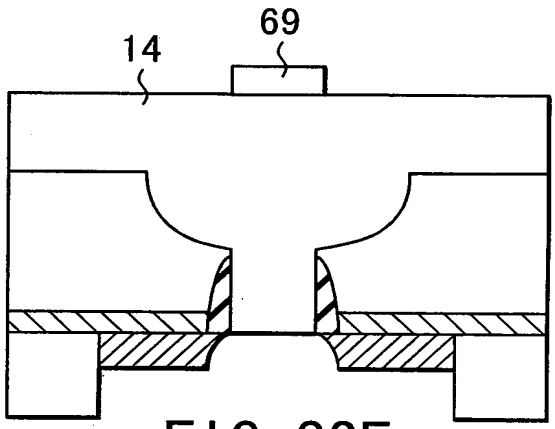


FIG. 32F

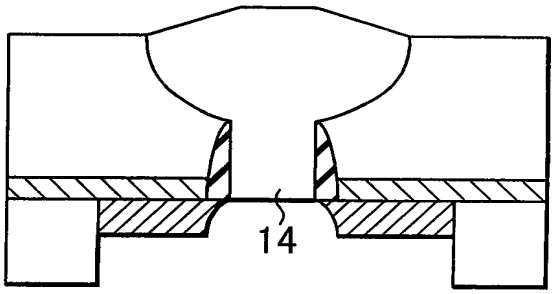


FIG. 32G

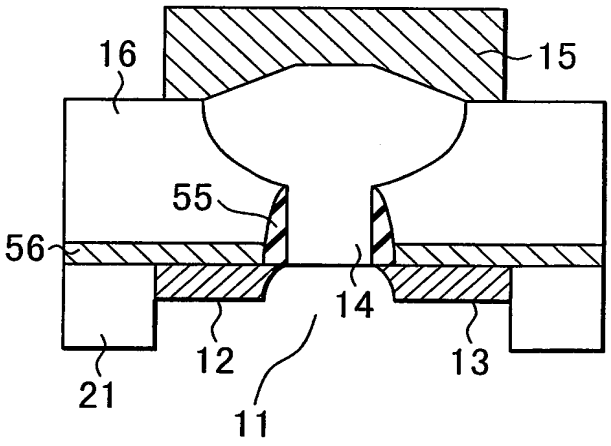


FIG. 32H

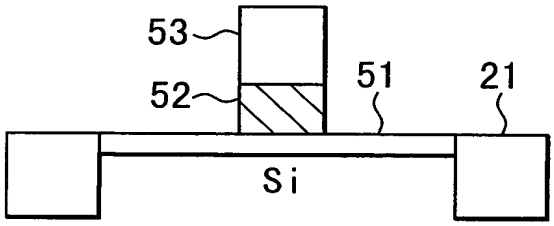


FIG. 33A

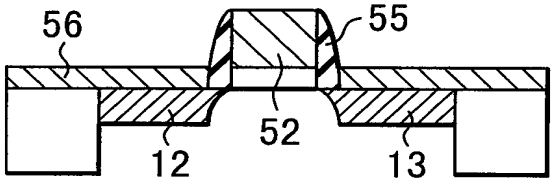


FIG. 33B

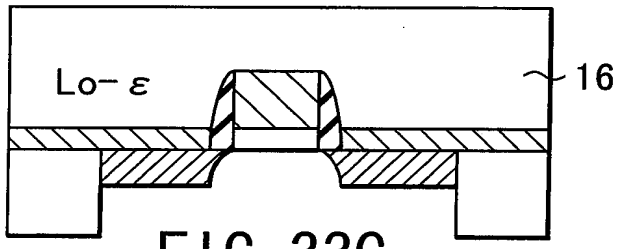


FIG. 33C

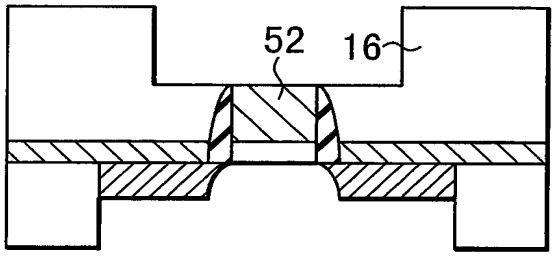


FIG. 33D

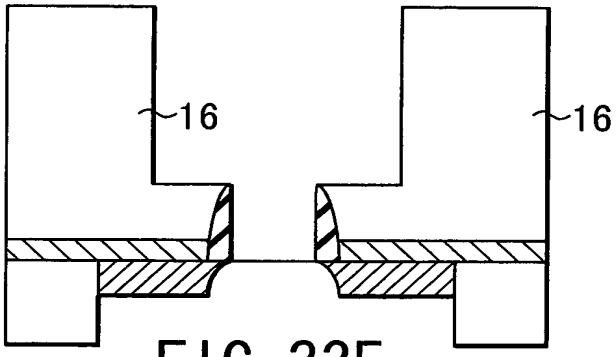


FIG. 33E

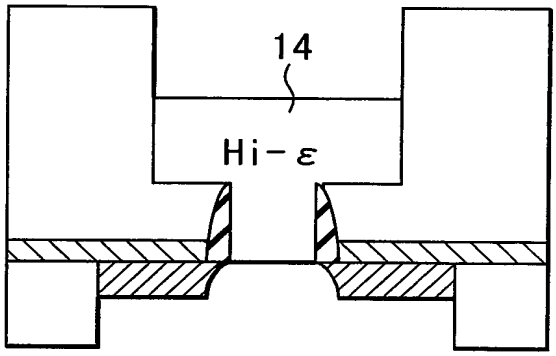


FIG. 33F

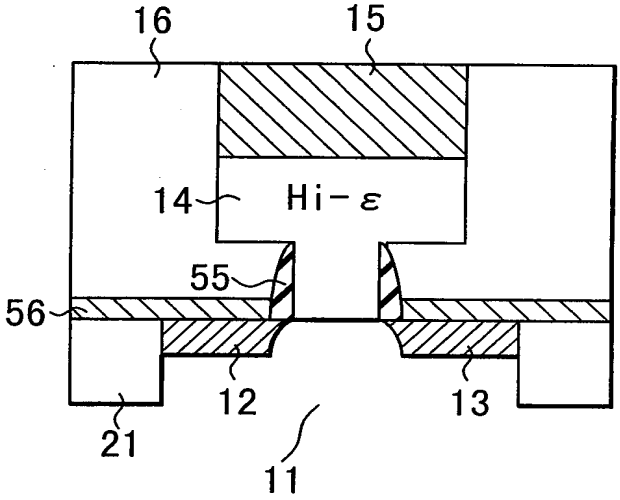


FIG. 33G

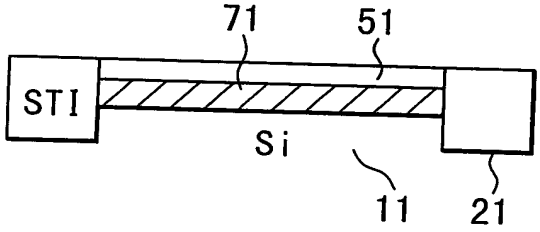


FIG. 34A

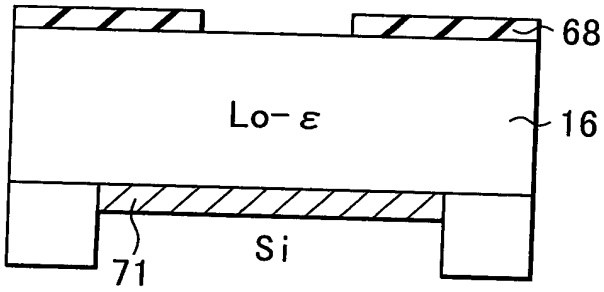


FIG. 34B

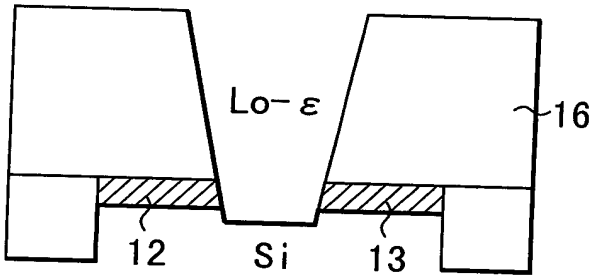


FIG. 34C

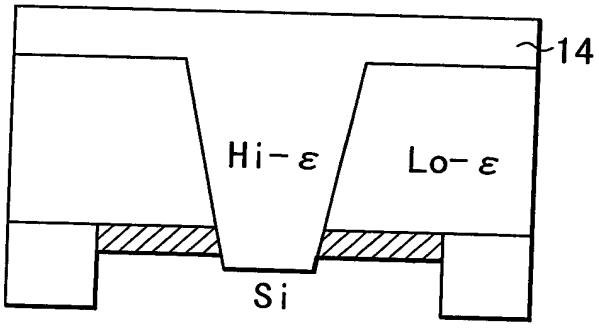


FIG. 34D

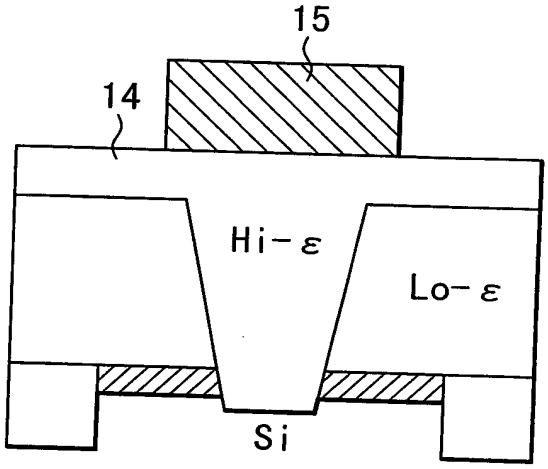


FIG. 34E

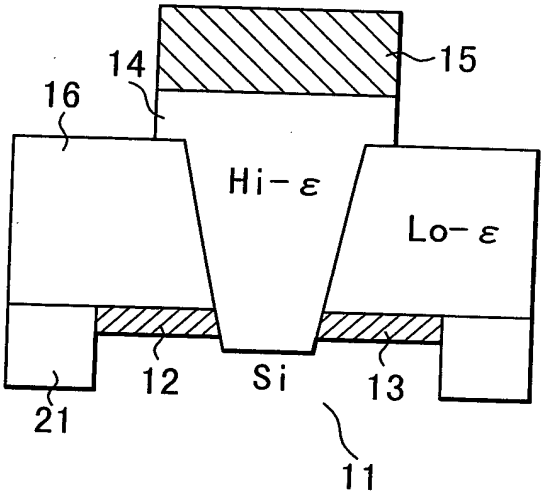


FIG. 34F

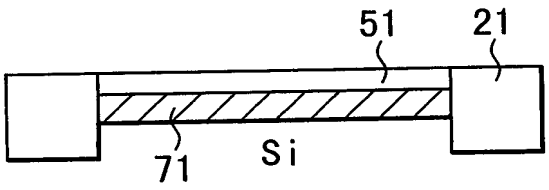


FIG. 35A

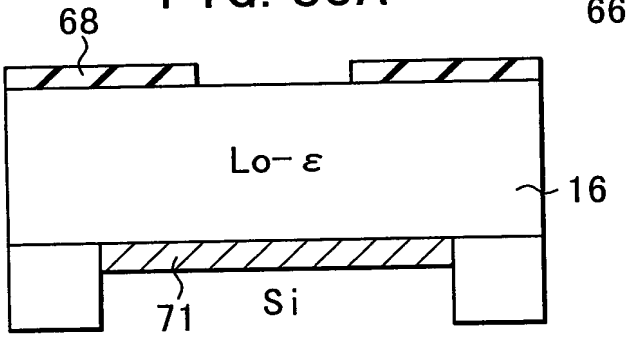


FIG. 35B

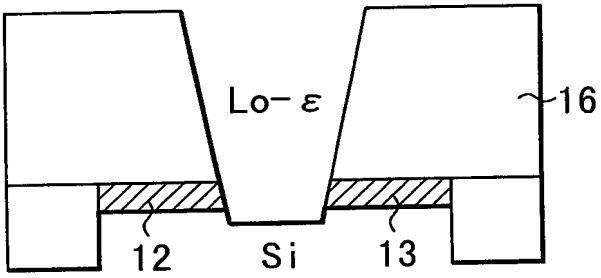


FIG. 35C

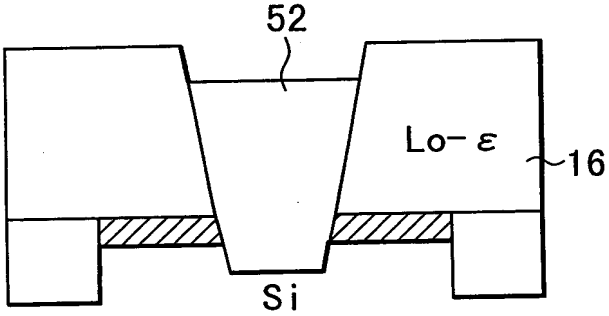


FIG. 35D

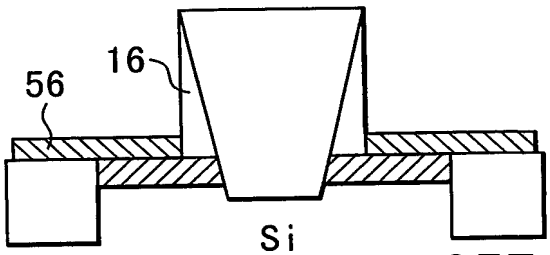


FIG. 35E

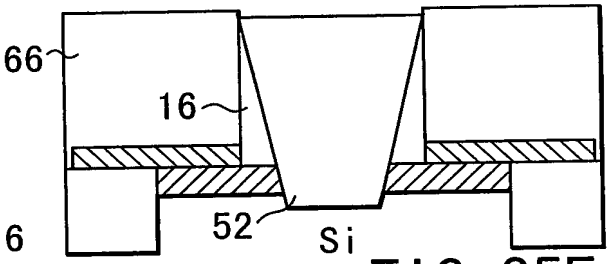


FIG. 35F

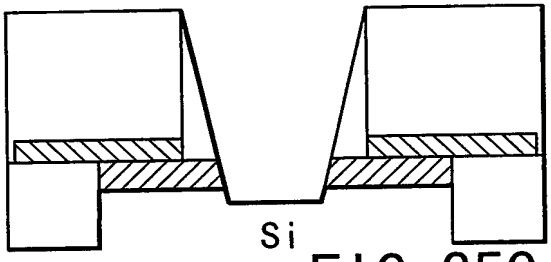


FIG. 35G

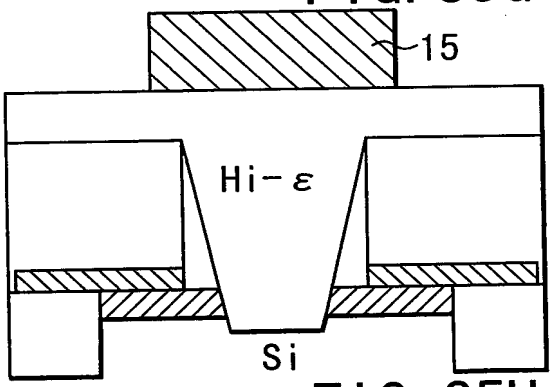


FIG. 35H

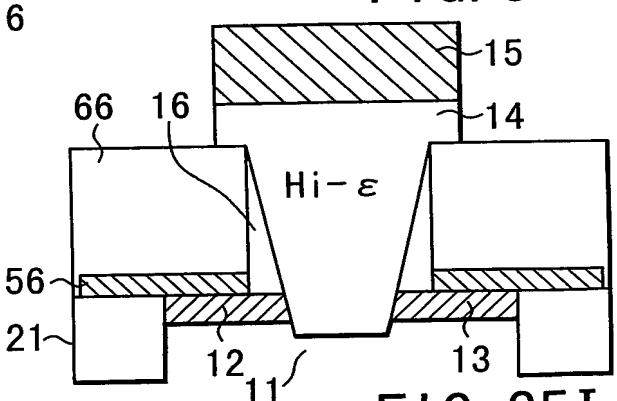


FIG. 35I